THE WORLD AROUND US

4

ENVIRONMENTAL SCIENCE FOR PRIMARY SCHOOLS

ORIENT LONGMAN

SOME BASIC TEACHING ASSUMPTIONS FOR THE SERIES

1 Knowledge is meaningful only when facts are made real to a child through experience. He thus learns not through passive listening and note-taking but through talking, perceiving and participating in activities related to the experience.

2 Basic intellectual and scientific skills must be developed – observation, reasoning, judgement, anticipation and curiosity.

3 The child must not be prejudiced but guided. Therefore, except on essential issues, judgements on facts and situations are not imposed.

4 The environment is too vital to be ignored. The emphasis should be on conserving the natural world and on developing attitudes of involvement and concern.

5 Children must express themselves – in words, in writing, in activity – and they must be given opportunities to do so.

6 There are usually a number of possible answers to a question, including the honest 'I don't know'. Children must be directed to the most satisfactory answer by hints and pointers, not a dismissing 'right' and 'wrong'.

Wrapper Printed at Nagaraj & Co., Madras – 41

THE WORLD AROUND US

BOOK 4

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ORIENT LONGMAN

BOMBAY CALCUTTA MADRAS NEW DELHI

BANGALORE HYDERABAD PATNA

© 1980 Orient Longman Ltd.

First Published 1980
Reprinted 1981

Orient Longman Ltd.

Registered Office:
3/5 Asaf Ali Road, New Delhi 110 002

Other Offices:
Kamani Marg, Ballard Estate, Bombay 400 038
17 Chittaranjan Avenue, Calcutta 700 072
160 Anna Salai, Madras 600 002
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80/1 Mahatma Gandhi Road, Bangalore 560 001
3-5-820 Hyderguda, Hyderabad 500 001
S. P. Verma Road, Patna 800 001

Acc No - 15457

Printed at

Navabharat Printers & Traders
231, Royapettah High Road, Madras 600 014

Published by
Sujit Mukherjee, Orient Longman Ltd.,
160 Anna Salai, Madras 600 002

TO THE TEACHER

The World Around Us is a set of six books of environmental science for primary schools. The environment physically presented is Indian, with features familiar to every Indian child.

The material is based on the topics listed and the emphases recommended in the recently revised syllabus of the National Council of Educational Research and Training (NCERT). Due attention has however been given to absorbing the recommendations in other primary-level syllabuses as well.

The series represents an effort to promote certain elements of thinking which are today recognised as crucial in teaching the environmental sciences. The environment is a dynamic, living, *changing* phenomenon. As human beings capable of thinking, doing and inventing, we exert the greatest influence on it. Man-made complexities and problems in modern living make it necessary for us to develop positive attitudes of concern for the environment and the desire to conserve its natural endowments and resources.

The material in the first three books is organised, as it is in the NCERT syllabus, under concept-heads with reference to the home and the family, the neighbourhood, the school and the outer world of space. A number of subjects are covered. The texts are profusely illustrated. Lessons have been planned and presented with a view to stimulating the child's interest and curiosity.

A special feature is the help offered to the teacher. In the Introductory Book and Books 1 and 2, this is in the form of detailed notes for each lesson. In the later books, teaching guidelines are built into the text and are self-evident. The teacher is of course free not to use the notes and to evolve his or her own methods of teaching. The teacher is also advised to repeatedly supplement the material in these books with activities that draw the child's attention to the local environment and its peculiarities.

The teacher's attention is drawn to the fact that in the first three books, topics and sub-topics have not been clustered together except at the beginning and in a few essential instances. This has been done to help avoid monotony and topic-grinding. The teacher is, however, free to follow a topic order in teaching if this is found preferable. In the books, the material is graded in order of comprehension difficulty and topics dovetail in a logical sequence.

In writing the books, every attempt has been made to appreciate the possibilities and limitations of the classroom situation. The authors, who are practising teachers themselves, are grateful to the many teachers consulted in the preparation of the books from whom they received comments, encouragement and advice. They are likewise grateful to the artists whose illustrations have brought these ideas alive.

M. VINCENT SIMON
JULIA FRANCIS

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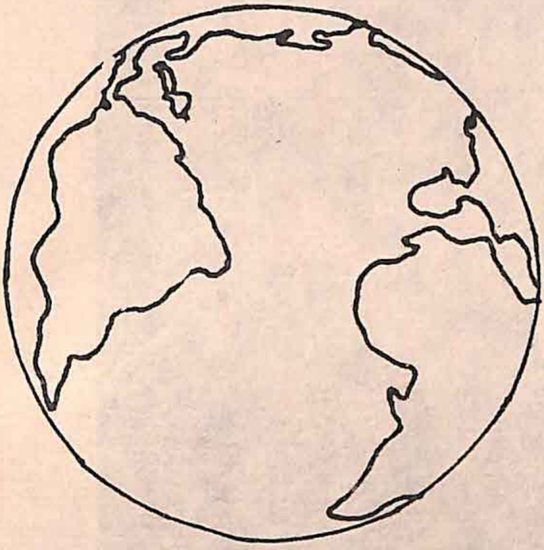
1 THE EARTH AND THE OTHER PLANETS



Look at the Earth, the beautiful Earth on which we live. It looks like this when seen from outer space. You can see the shapes of the land and the vast spread of water all over — the oceans and the seas.

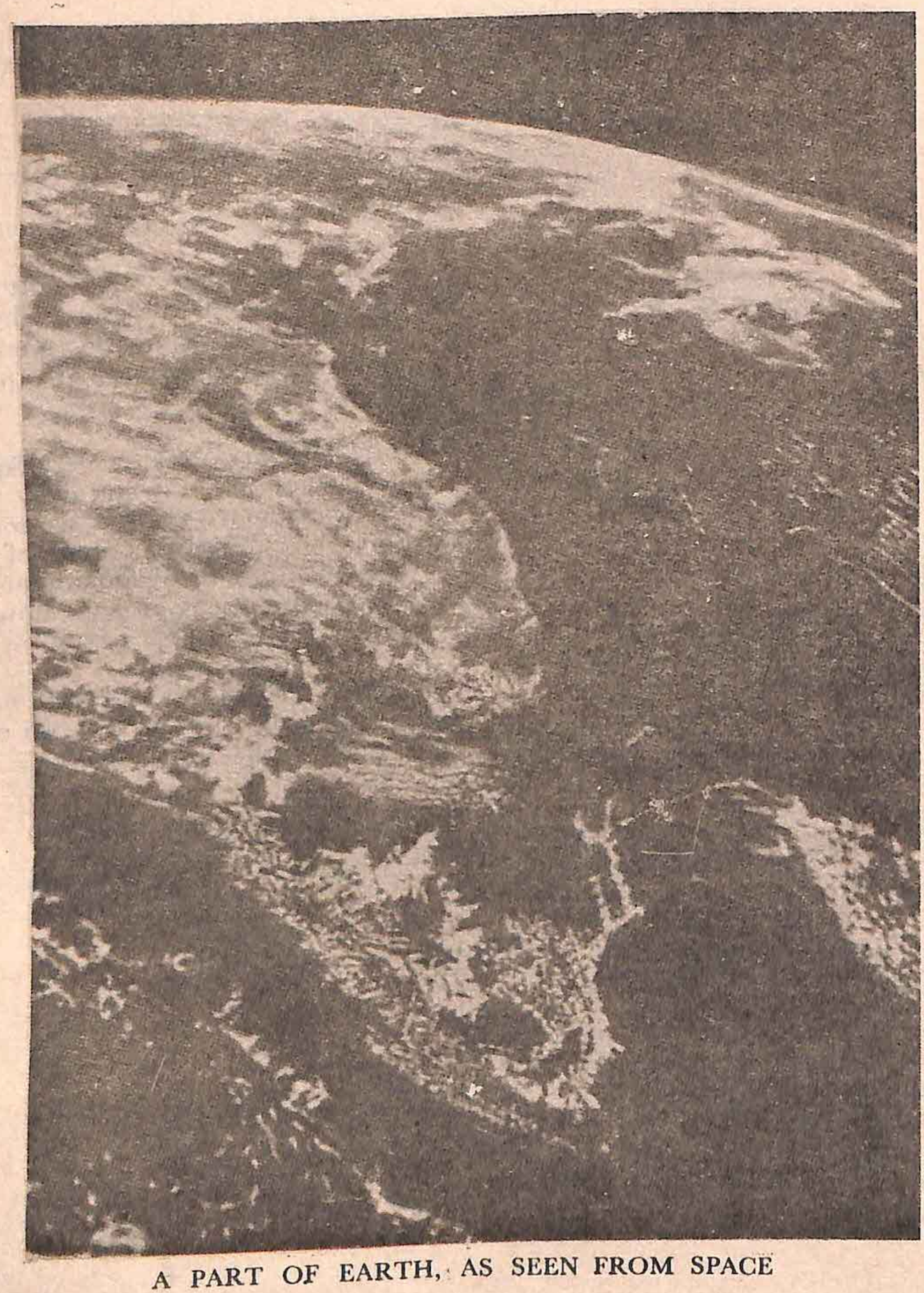
The Earth is a planet. It is part of a large universe made up of other stars and planets. We can only see some of these in the night sky. Scientists and astronomers can barely see the distant stars even with their biggest telescopes.

The Earth, along with eight other planets goes round the Sun. The Sun is a star, the nearest to us, even so it is almost one hundred and fifty million kilometres away!

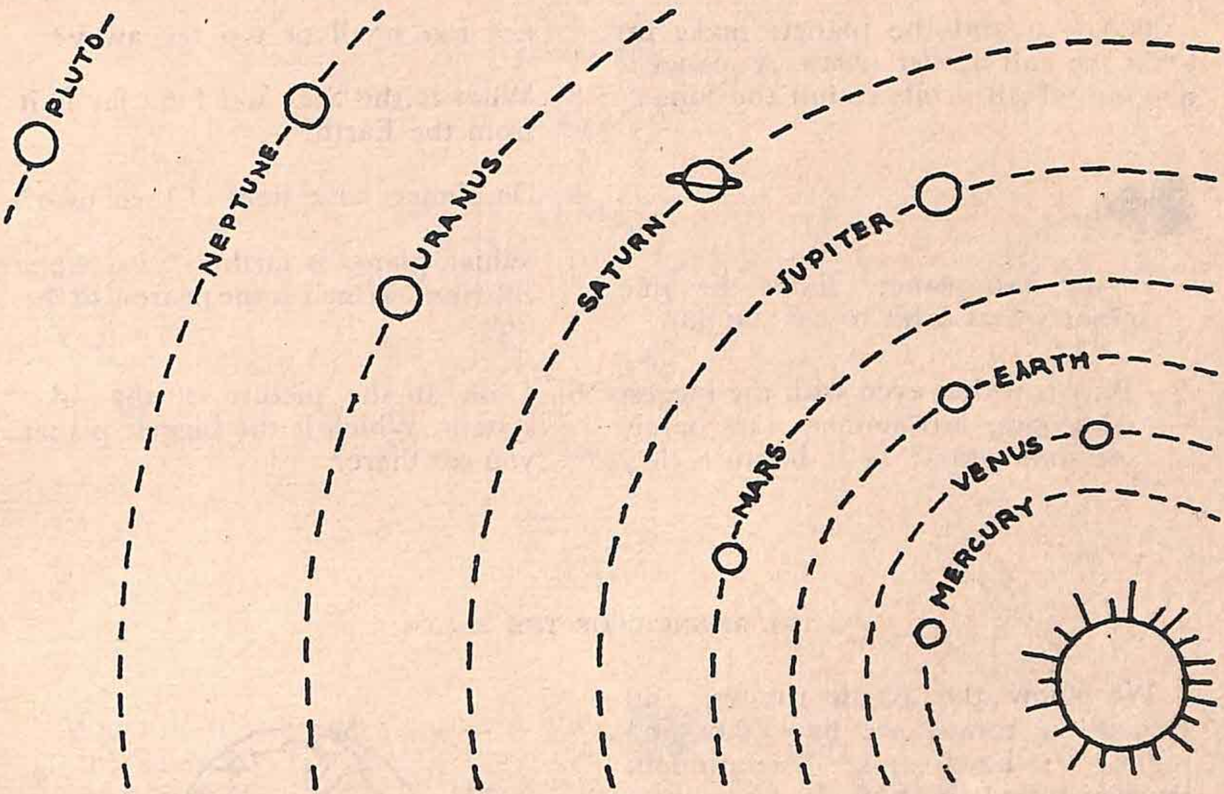
Most stars are very much like our Sun, but they are too far away to be seen in the same way that we look at the Sun. We can only see some of these as tiny stars at night. By looking at their light, astronomers can say how far away they are.

The Sun gives light and heat to the nine planets that go round it. In order of closeness to the Sun they are

Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto.

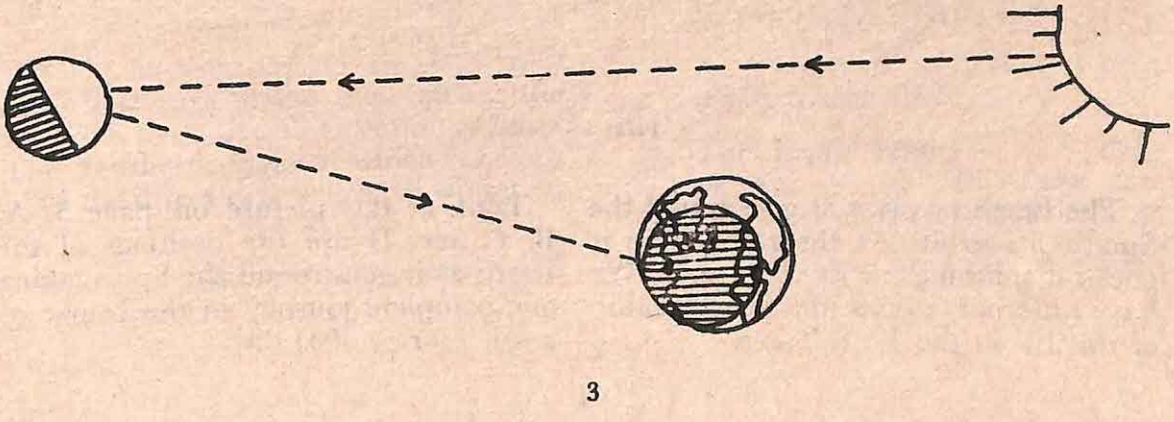


A PART OF EARTH, AS SEEN FROM SPACE



Here is a picture of the track or *orbit* the planets take round the Sun. They move, of course, at different speeds.

Planets are not stars, they do not have their own light. They *reflect* the light from the Sun. Here is a picture to show you how this happens:



The Sun and the planets make up what we call a *solar system*. A planet is a body which orbits round the Sun.

What is a planet? Name the nine planets that orbit round the Sun.

2 Why is it that even with the biggest telescopes, astronomers can barely see some stars? Is it because they are too small or too far away?

3 What is the Sun and how far is it from the Earth?

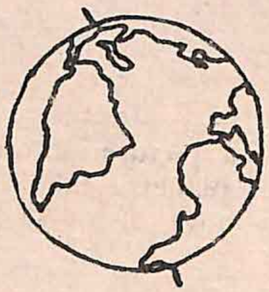
4 Do planets have light of their own?

5 Which planet is farthest away from the Sun? Which is the nearest to the Sun?

6 Look at the picture of the solar system. Which is the biggest planet you see there?

THE SPINNING OF THE EARTH

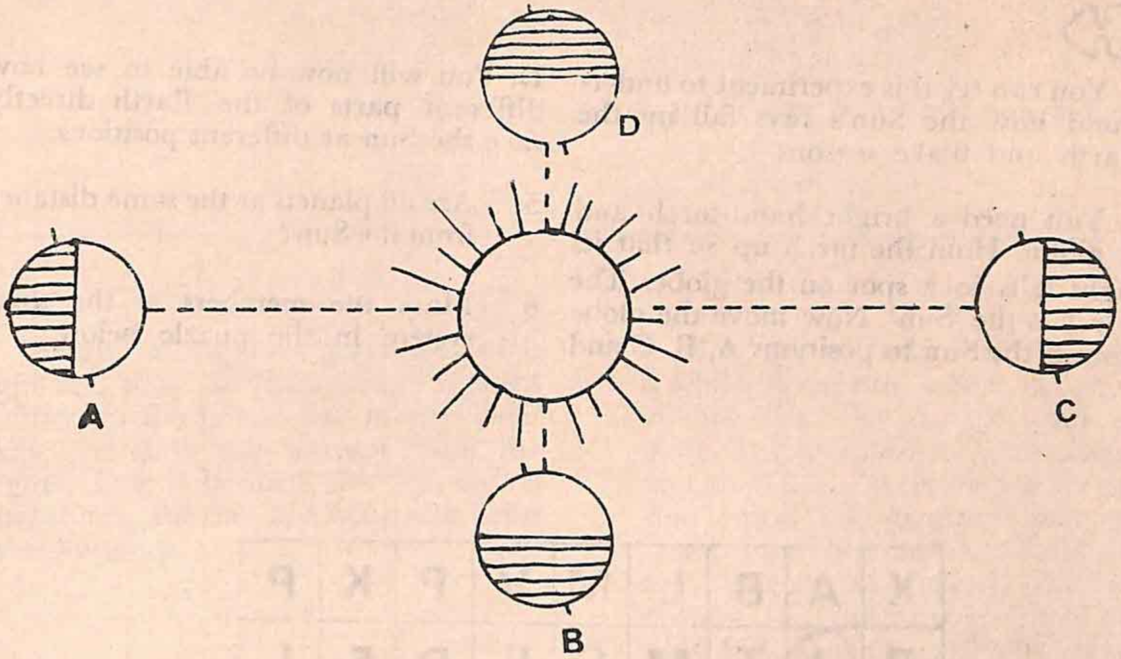
We know the Earth rotates, and because it rotates we have day and night. The Earth makes a continuous journey round the Sun. It moves in a tilt. This globe will help you understand how the Earth spins on a tilted axis. It takes the Earth $365\frac{1}{4}$ days to move exactly once round the Sun. We say that it takes a year for the Earth to do this.



THE SEASONS

The Earth revolves or goes round the Sun in its orbit. At the same time it goes on spinning on its tilted axis. We have different seasons in a year because of this tilt in the Earth's axis.

Look at the picture on page 5. A, B, C and D are the positions of the Earth as it goes round the Sun making one complete journey in the course of a full year or $365\frac{1}{4}$ days.



When the Earth is in position A and C, the Sun's rays fall directly upon the central part of the Earth. The north and the south receive equal sunlight.

Now compare position B of the Earth with position D. In which of the two positions does the north get more sunlight?

What happens is this: in position B the direct rays of the Sun fall on the northern parts. It will be summer there. The southern regions which do not have the direct rays will have winter.

What can you say about position D in the picture?

H

1 What is an orbit?

2 Which two planets are near the Earth?

3 How does the Earth have different seasons?

4 Fill in the blanks:

a. A ——— is a body which orbits round the Sun.

b. The Earth takes ——— days or one ——— to make one complete journey round the Sun.

c. The Sun and its family of planets is called the ———.

You can try this experiment to understand how the Sun's rays fall on the Earth and make seasons.

You need a bright hand-torch and a globe. Hold the torch up so that its light falls in a spot on the globe. The torch is the 'Sun'. Now move the globe round the Sun to positions A, B, C and D. You will now be able to see how different parts of the Earth directly face the Sun at different positions.

5 Are all planets at the same distance from the Sun?

6 Mark the members of the solar system in the puzzle below.

X	A	B	L	M	V	P	K	P
R	J	T	M	C	E	D	E	L
M	T	U	R	A	N	U	S	U
E	S	L	P	K	U	J	U	T
R	A	V	M	I	S	M	N	O
C	T	E	A	R	T	H	Z	R
R	U	X	R	V	M	E	N	O
Y	R	P	S	Q	R	S	R	T
N	N	E	P	T	U	N	E	M

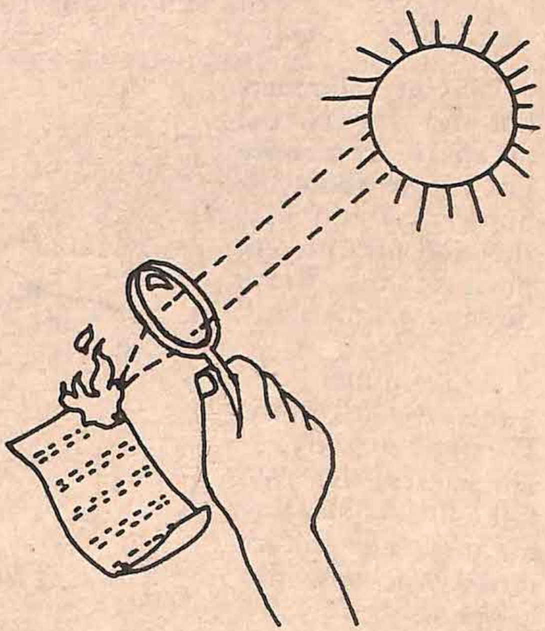
2 AIR, WATER AND WEATHER

The Sun as we know gives the Earth light and heat. In the summer months it dries up the ponds and lakes. Generally, the days are warmer than the nights. This is because the Sun shines only during the day and warms or heats everything up.

1 Place a saucer of water in the sunlight. Touch the water. Touch it again after half an hour. How does it feel now? What does this tell you about sunlight?

2 Here is an interesting thing to do on a bright day. Be sure your teacher is around to watch and help. You will need a magnifying glass (a magnifying glass, as you probably know, magnifies or makes things larger when you see them through the glass, so that you can see them better.)

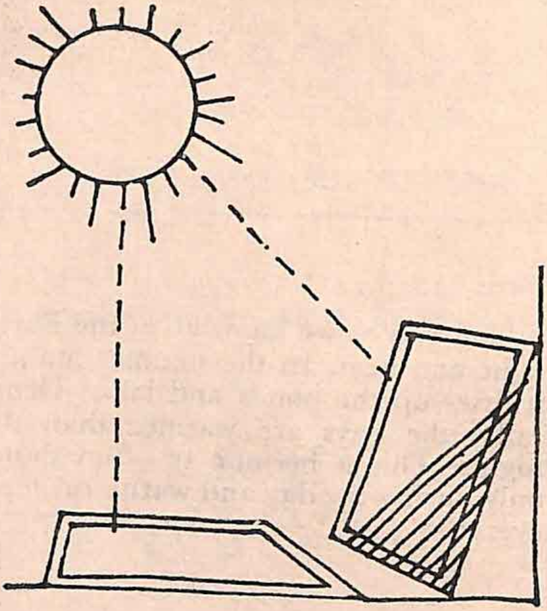
Take a piece of cotton wool or paper. Hold the magnifying glass over it in such a way that you can see a point of sunlight on the cotton wool or paper. Hold it steadily for a while. Soon this 'point' becomes so hot that the cotton wool or paper begins to burn. This shows you that the objects on which the Sun's rays fall directly, heat up faster than objects on which the rays do not fall directly. In the case of the magnifying glass, the glass has a quality which makes the Sun's rays bend at a single point.



3 Get two classroom slates. Remember that slates heat easily.

Place one of the slates in the sunlight flat on the ground. Place the other also in the sunlight but in a slanting position as shown in the picture. Leave the slates in this position for five minutes.

Which is warmer to the touch? Do you know why?

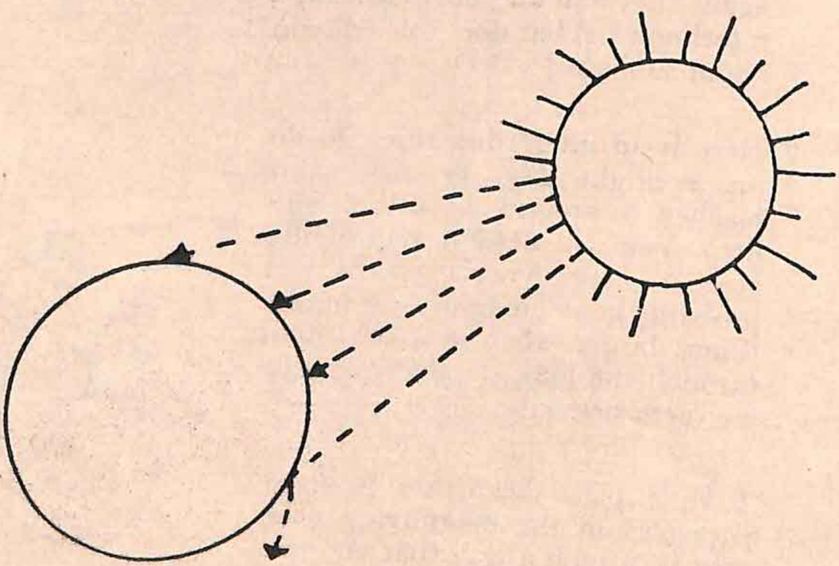


These experiments tell us two things — one, that the Sun heats the Earth, two, that when the Sun's rays strike an object directly they heat the object much quicker than if the rays fall on the object in a slant.

THE SUN WARMS THE EARTH MORE IN SUMMER

Why are summers hot and winters cool or cold? You have just learnt about the Sun's rays and how they fall on different parts of the Earth directly or in a slant.

In summer the Sun's rays fall on the Earth directly. In winter the rays fall in a slanting manner. The picture shows you how this happens.



When the sunlight falls in a slant, it falls over a *larger* area, so that the same heat gets spread over a large area. This happens in winter. When the sunlight falls directly, the rays fall close together over a small area. This happens in summer.

In summer, the Sun is directly above us. The Earth's axis tilts it so. The days are long. During winter the Sun is not directly above us. We are not able to see the Sun for as long as we are able to do in summer. The days are short and the nights are longer. See that the water and the sand are level. Place both dishes in the sunlight for an hour. Which feels hotter, the sand or the water?

This experiment helps you understand that some things heat more quickly and get hotter than others. If you have done the experiment carefully, you will also understand why land portions of the Earth heat up sooner than the seas and oceans.

1 Describe an experiment to show that things heat faster when the Sun's rays fall directly on them.
2 Why do we have seasons? Explain this with a picture.
3 Why are days long in summer and short in winter?

1 What do you do to cool yourself on a hot day?
2 What have you seen other people do on hot days? Animals? (Think of dogs, cats and buffaloes.)

We have seen how land heats up faster than water. Now the strange thing is that land also *cools* faster than water.

Take a dish of sand and a dish of water (the two dishes must be similar).

Keep the dishes in the shade for some time. Which one cools faster?

EVAPORATION

Have you watched the water boiling in a pan? You can see the clouds of steam rising from the boiling water. The water is drying up and going off into the air. We have learnt already about water vapour. You will understand water vapour better if you think of it as water in the form of invisible air. This 'drying up' of water and its becoming water vapour is called *evaporation.*

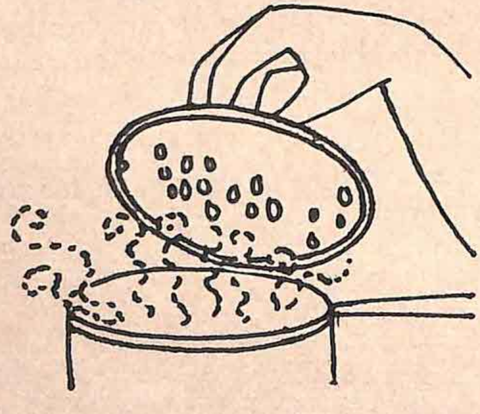
We see examples of evaporation around us every day – when you scrub the floors and the water 'disappears', when you clean the blackboard with a damp cloth; or even when you hang out clothes to dry in the sunlight.

Now we also know that clothes dry faster on hot, windy days. The sunlight dries up the water with its heat, the dry wind carries away the water particles. Both the Sun and the wind help evaporation.

There is another interesting thing about evaporation and drying. Clothes dry quicker if they are spread out fully than if they are hung in folds. Can you say why this is so?

Yet another fact about evaporation is that the drier and hotter the air, the sooner evaporation takes place. If the air is damp it cannot take or absorb water quickly because it is already full of water particles in the form of vapour.

CONDENSATION



When you take the lid off a pan of hot water, you see that the steam on the lid quickly changes into drops of water. We say that the steam has *condensed* into water. Condensation is the very opposite of evaporation. In evaporation the heat changes water into vapour. In condensation, vapour changes into water when it comes in contact with the cool air.

Another common example of condensation is when we take a bottle of cold liquid out of the refrigerator. The bottle begins to 'sweat'. In Book 3, we saw how this is because the water vapour in the air hits the colder surface of the bottle. Condensation takes place and the water vapour changes back into water.

1 What is evaporation?

2 What conditions help evaporation?

3 Why do clothes dry much faster when they are spread out than if they are hung in folds?

4 How does condensation take place?

5 Draw a water-cycle chart to show how the cycle of evaporation and condensation take place continuously.

WEATHER IN OUR LIVES

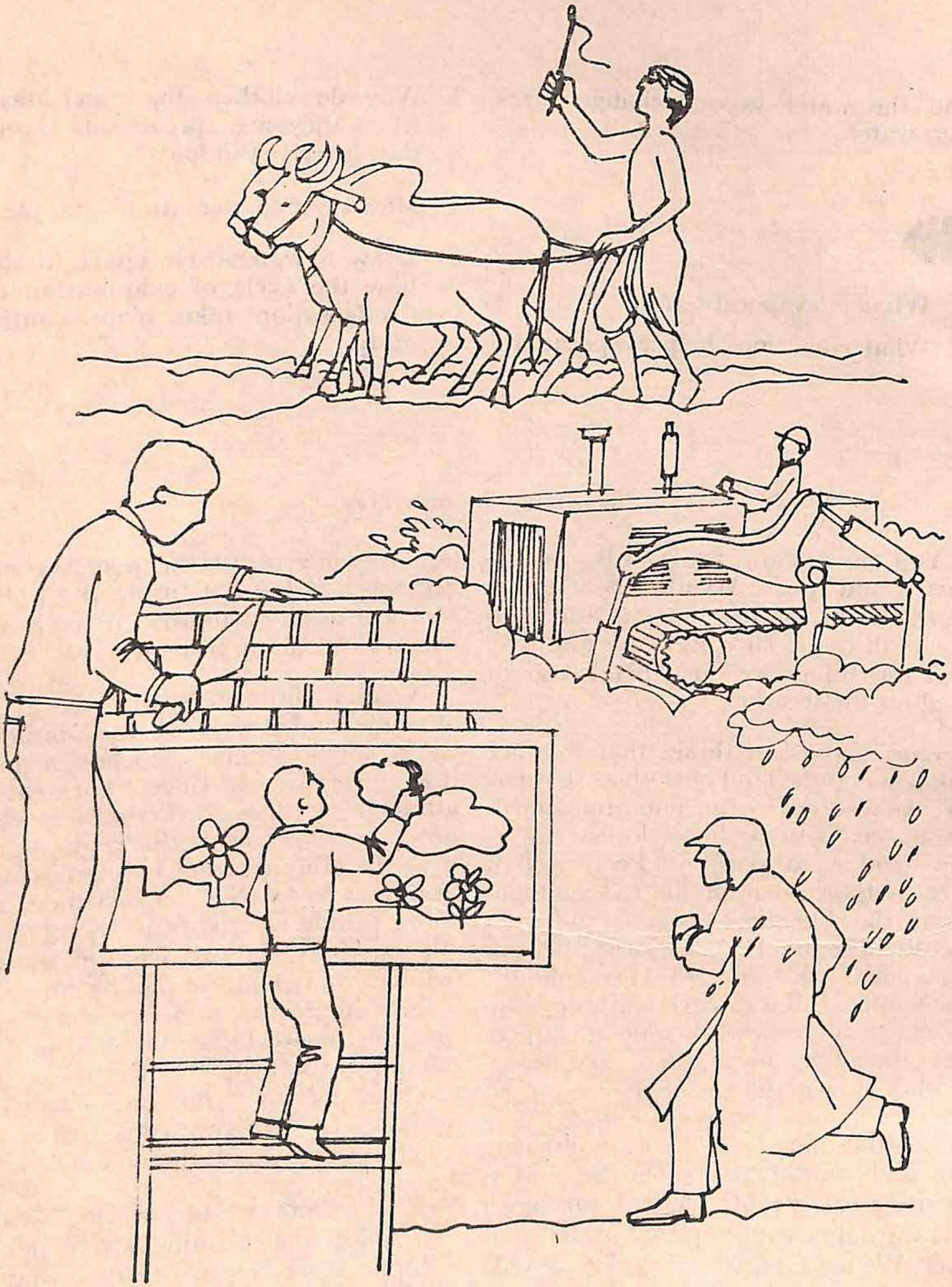
You now know the words *weather*, *climate* and *season*. Weather is a simple word; let us for the moment use it to mean all three. How we work and live, and the things we do depend a great deal on the weather.

One of the first things that weather influences is the kind of clothes we wear. We know that in the hot summers in India, people wear light clothes and as few clothes as possible. People often wear hats or use umbrellas to keep them from the burning sun. In the cold weather it is all of course quite different. Some places in India get very cold in the winter and some, like Kashmir, even have ice and snow. People then take out their woollens and other warm clothes to keep out the cold.

Weather also commonly influences our daily routine and often the kind of food we eat. People try to think of all the ways they can keep cool in the summer. We use fans, we drink lots of cold liquids, some people sleep in the open because it is too hot inside the houses. Many of us go swimming or have cold-water baths many times a day!

Weather influences our work and often the kind of work we do. A builder's work, for example, depends a great deal on the weather. In very hot weather, although he does work the heat slows down his work and bothers him a great deal. In rainy weather he cannot work at all (why?). Nor can farmers and other people who work in the open. In places where there is ice and snow in winter, many kinds of jobs become difficult or impossible to do. In some countries of the world, houses become 'ice-bound' that is, the ice is so thick everywhere that no one can move around. In such countries people store food to eat through the winter.

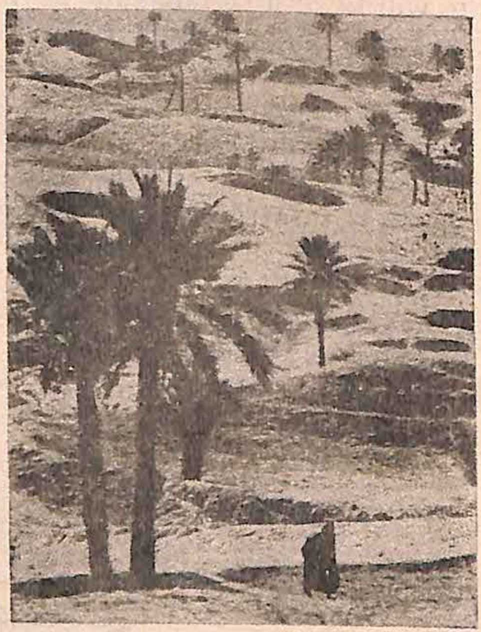
Everywhere in the world, weather has followed a certain pattern or *cycle*. People know more or less what the

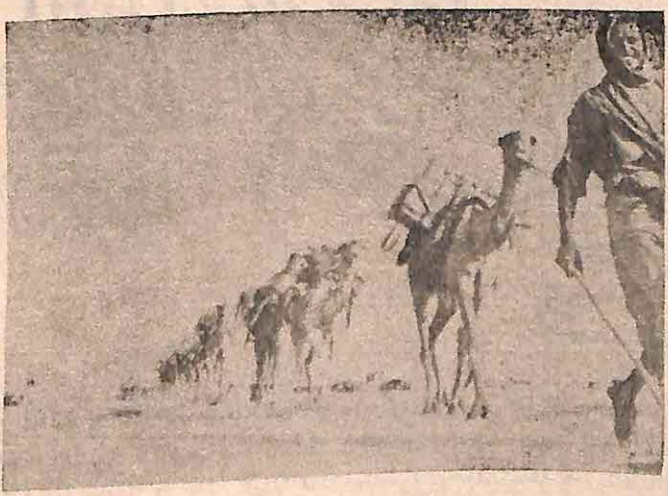


climate will be at a certain time of the year. The cities and places on the south-west coast of India expect the monsoons in June every year. In England they know the trees will begin to shed their leaves in autumn, which begins around September. It is because we *know* what weather to expect that we plan our work in a certain way. Farmers, for example, will think of ways of 'using' the monsoon to water their crops, or think of ways of storing the water for use later. If the rains fail, they are put to great hardship.

Animals and plants are also, of course, influenced by the climate and the changes in it. As we know, not all animals can live (we use the word 'survive') in all climates, and in just any part of the world you put them in. A tiger, for example, is used to a warm climate, and would find it impossible to survive in ice and snow. A polar bear would die in a desert.

This is a good time for us to learn the word *habitat*. When we talk of an animal's habitat, we are talking of its surroundings and the other natural conditions in which it lives and is able to survive. Habitats are therefore very important in our lives, and in the lives of plants and animals.





Habitats

1 In what different ways does weather influence our lives?

2 How does the cycle of weather influence us? What happens if there is a change or break in it?

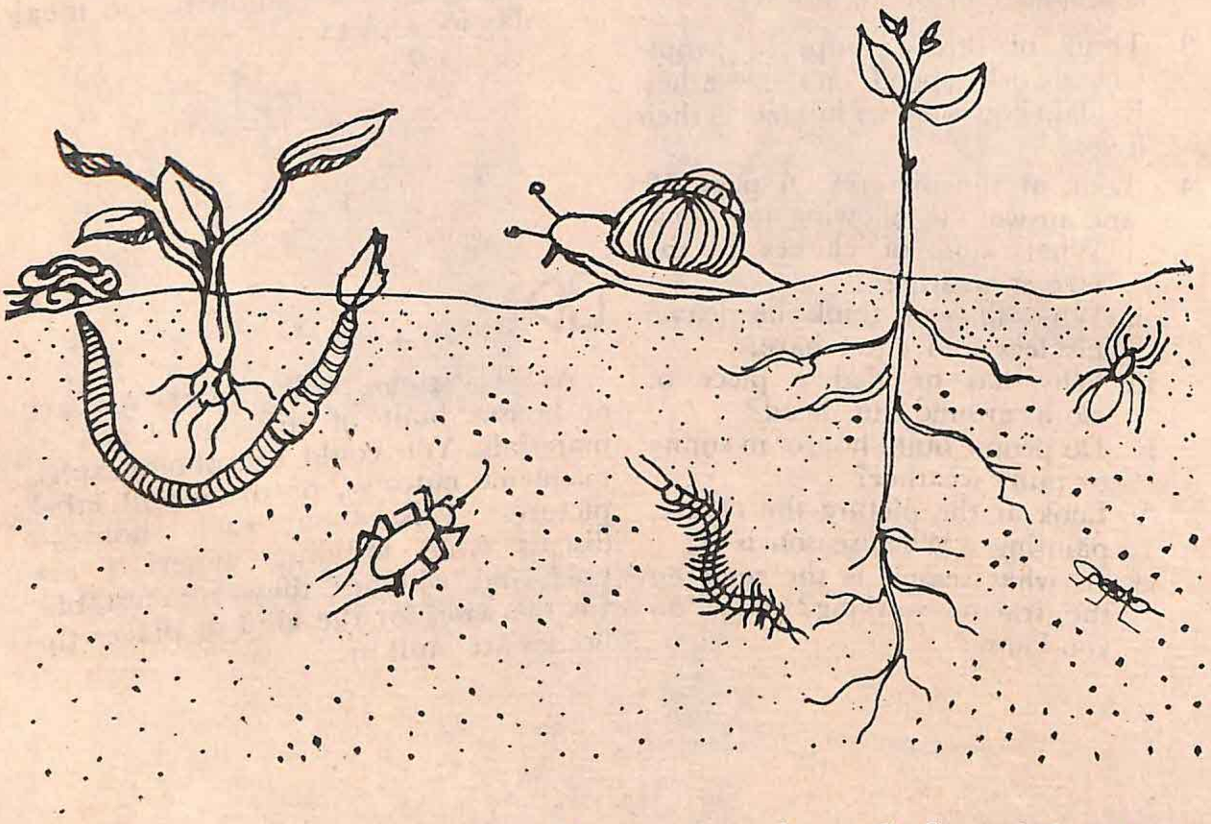
3 Think of three groups of people whose work depends on the weather. Explain how weather influences their lives.

4 Look at the pictures on page 12 and answer the following questions:
  i What kind of clothes is the farmer wearing?
  ii Why do you think he leaves his legs and chest bare?
  iii Why has he tied a piece of cloth around his head?
  iv Do people build houses in sunny or rainy weather?
  v Look at the picture the man is painting. What season is it?
  vi In what season is the man on the tractor working? How do you know?
  vii Why is the man in the last picture wearing a cap and a long coat?

5 Draw a picture showing an ideal day for a picnic.

As a classroom project, make a chart of houses built of different kinds of materials. You could use photographs, magazine cuttings, or draw and label pictures. Talk about each house—discuss what building materials are used and whether they are suitable, weatherwise, for the kind of places the houses are built in.

3 THE SOIL AND EROSION



In Book 3 we learnt how the soil on the Earth was formed over thousands and thousands of years, and how it continues to form in this way. We know why soil comes in so many different colours and textures and contains so many different things: rocks, minerals and what we call organic matter.

As we know, the Sun, wind and water are always changing the surf ace of the Earth. The heat of the Sun causes rocks to expand. Some rocks expand so much that they crack, or the heat makes so many cracks that they crumble and loosen up. Let us see how some of these things happen.

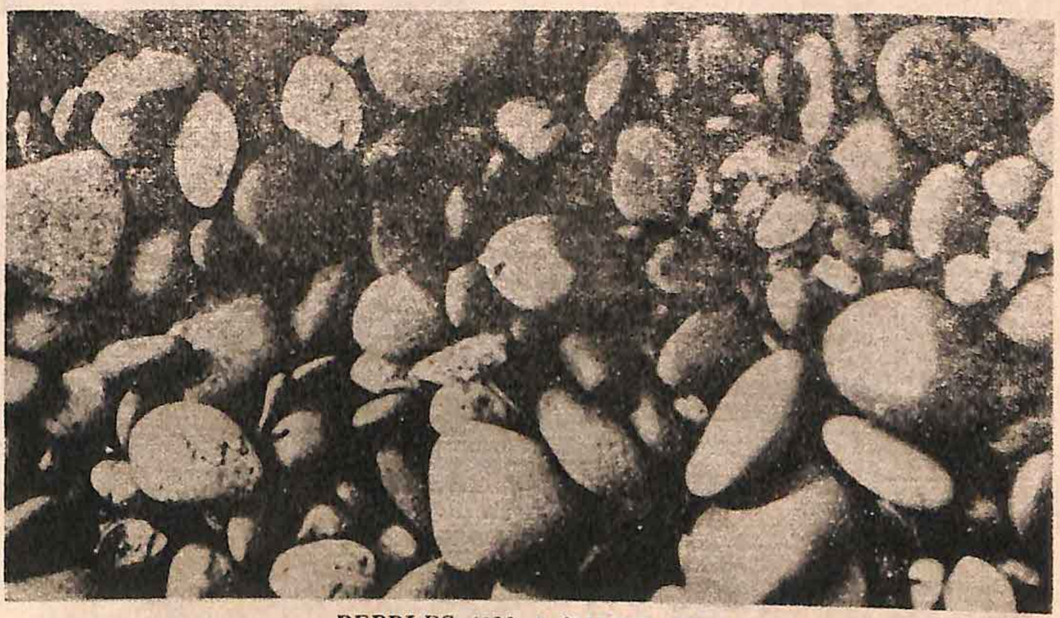
The Sun heats the rocks and they expand. Sometimes, if there are weak parts, the rocks crack in these places as they expand. At night the rocks cool again rapidly. This happens every day and night — that is, the rock expands and shrinks in turn when it heats and cools — until it cracks apart into smaller bits. The softer rocks and stones crumble and become larger particles in the soil.

Some trees and shrubs grow on rocks. Their roots pierce the rocks and make cracks in them. Some roots are strong enough to cause the rock to finally break. When it rains the cold water collects in these cracks. In cold climates this water freezes and expands, and this causes the rock to crack further.

The force of water from waterfalls and rivers can also cause rocks to break and crack.

In the heading of this chapter, there is a new word, *erosion*. To erode something is to wear it away and to somewhat change its shape. Land is eroded mainly by water and wind. Both water and wind are constantly changing the shapes and forms of things.

You may have seen how rocks in a river-bed are smooth, they do not have sharp edges. This happens because the water is moving over the rocks all the time. It erodes the edges, and after a long time makes the rocks smooth. We call them smooth stone pebbles. In the

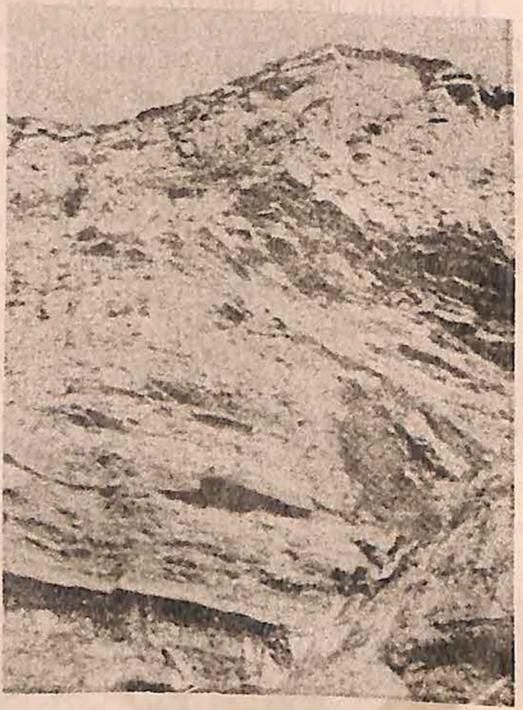


PEBBLES ON A RIVER BED

mountainous places waterfalls splash down on rocks. Sometimes this water falls with such force that it breaks the rocks and the pieces roll down with the rushing water. As they roll, the sharp edges are smoothened by the water and by rubbing against other rocks.

The wind also erodes land. You may have seen how in windy weather, sand is blown around in great clouds. It is blown from one place and carried to another.

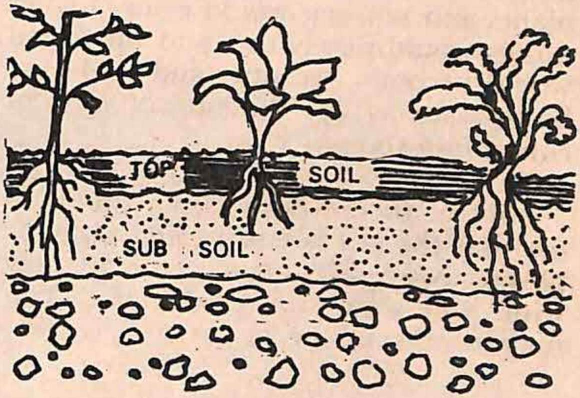
Example of wind erosion→



Water erosion
↓

SOIL AND ITS LAYERS

Soil on the Earth is found in layers. They are usually of different colours. and the soil in each layer feels different if you touch it.



The soil on the top layer, the layer you can see when you walk on the ground, is called the *top soil*. Plants grow in this soil. Top soils are, of course, of many different kinds, and different plants grow well on different kinds of top soil.

The lower layers of soil are called the sub-soil (*sub* is a word meaning 'below') layers. Plant roots, especially the longer ones, sometimes find their way into the sub-soil layers.

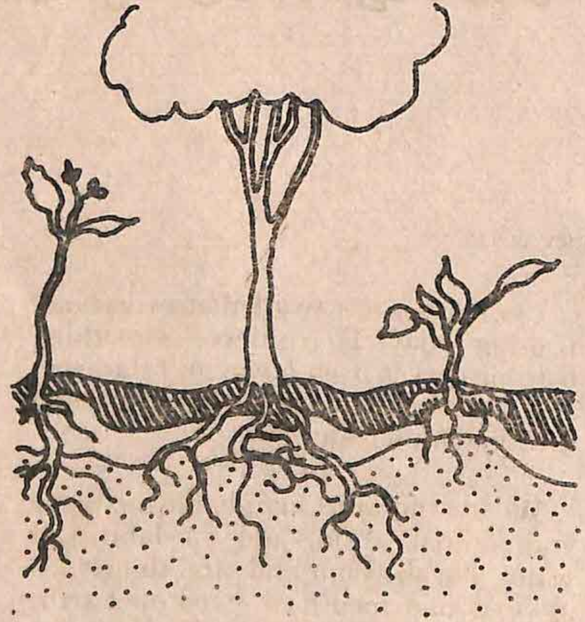
SOIL CONSERVATION

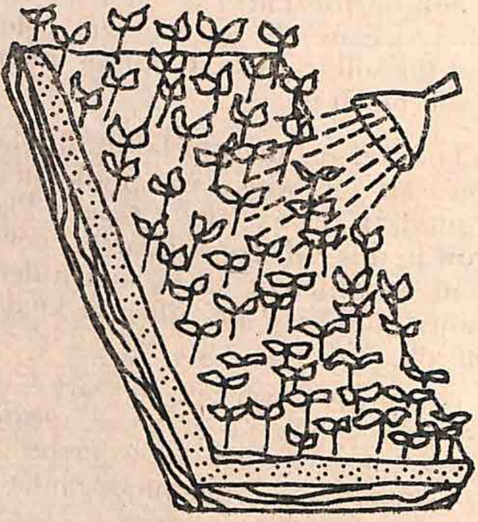
Conservation is a word that everybody is using today. To 'conserve' something is to protect it from harm and damage, and to make certain that it is not being used badly and wasted.

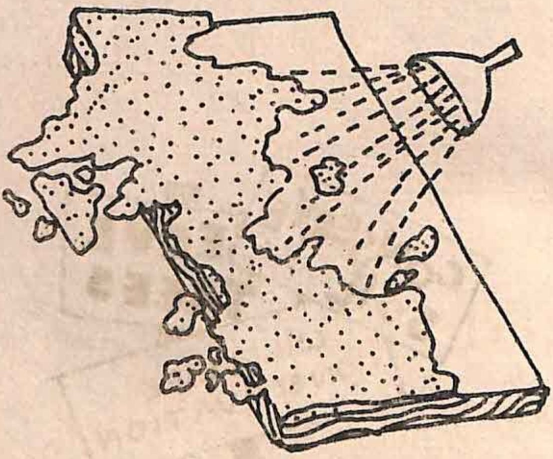
We use the word mainly for the plant and animal world, and for land and water. For the thousands and thousands of years that men have lived on Earth, they have not always been caring and careful about nature. When men learnt farming, they began to cut down trees and plants for farming space. They hunted animals first for food, later for the skins and for the adventure of hunting.

The soil of the Earth is rich, it is full of precious things to keep life going. Without soil and the many precious things it contains, there would be no plants and nothing would grow Living things would slowly die, and the Earth would become empty and lifeless So men today are thinking of ways of conserving the soil.

One of the ways of doing this is to see that the soil is not washed away or blown away. We have just read how wind and water can erode land. You may have seen how, in the rainy season, the soil in a playground is washed away. You can even see strong winds carrying away great clouds of soil. When this happens, plants and trees help to 'hold down' the soil. They can prevent it from being washed away. This happens mainly because the roots of the bigger plants and trees grip the soil.

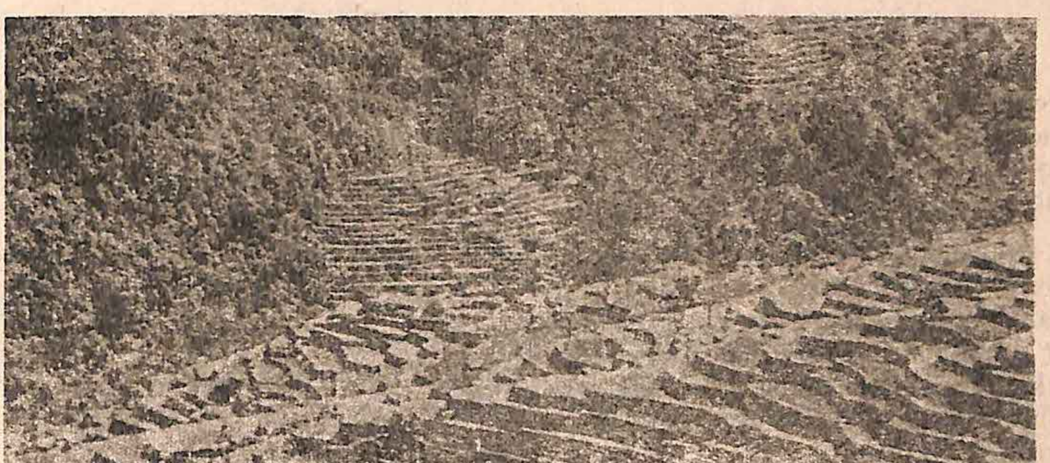






You can see more clearly how this happens if you try a simple experiment. Take two planks of wood. On one spread a layer of soil and plant mustard or some other quick-growing seeds in it. Wait until the plants have grown a little. Now on the other plank, spread

Terraced cultivation



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a layer of soil. Pour water on both the plants with a sprinkler. You will see that the soil on the second plank is washed away easily. If you pour the water with greater force, you can wash it all off, in fact.

People everywhere in the world are trying to conserve soil by planting more trees, grass and plants. In some places, they are making sure that no one cuts down trees or cuts them without planting something else in its place.

Another way of preventing soil from being washed away is by building low dams with stones and earth. These dams or bunds are raised at the edges of lakes and fields to retain the water. The extra water is allowed to go only through canals.

On page 22 is a picture of a tea-estate in a hill-town. Crops are grown on the hills by cutting away the sides of the hill in such a way that you have 'steps' of flat land or terraces. The water flowing down a terraced hill is slowed down by these terraces and will flow slowly.

1 How does nature break rocks into smaller pieces?

2 How does the soil get its organic matter?

3 Why are the pebbles in a river-bed usually smooth?

4 What are the two forces which erode land, and how do they work?

5 What are some of the ways in which people can prevent the land from being eroded?

6 What does the term 'soil conservation' mean to you?

What would happen if it were not conserved?

7 Say whether these are 'true' or 'not true':

a. Top soil needs to be protected from wind and flowing water.

b. Top soil is not very useful for plants.

c. Terrace-farms in the hills do not help the soil from being washed away.

d. Bunds help rivers and lakes from flooding our lands.

8 Choose the correct words:

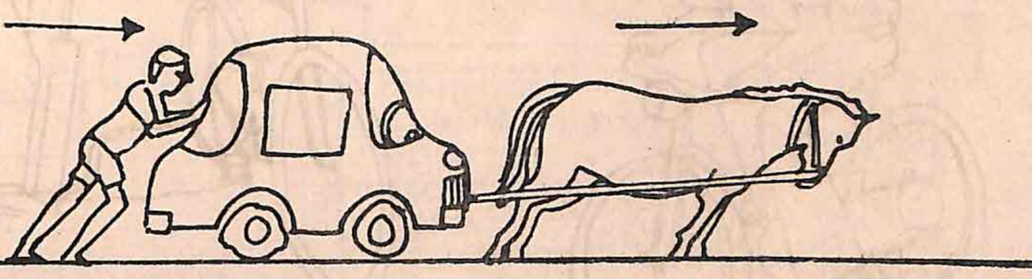
The soil deposited by rivers is called ________. (silt, humus)

Bare soil may be protected from erosion by ________. (plants, animals)

Rivers often carry top soil from the hills to the ________. (hills, plains)

Wind and water are agents of soil ________. (conservation, erosion)

4 FORCE, WORK AND ENERGY



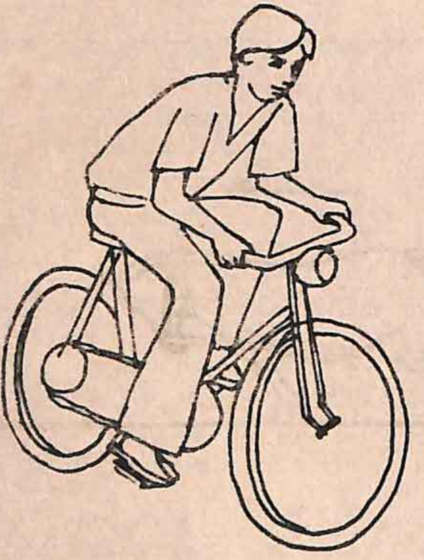
Look at this picture. The man's car has stopped, it cannot go. It does have petrol, but the engine has broken down and it cannot use the petrol to move the car. It will have to be repaired before it can do that.

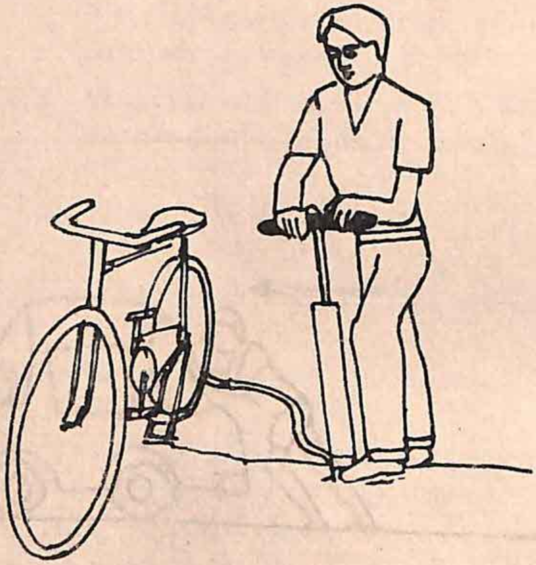
But the horse can pull the car. It has eaten and so has the strength or the *energy* to pull the car. It gets the energy from the food it eats. So does the man who is pushing the car.

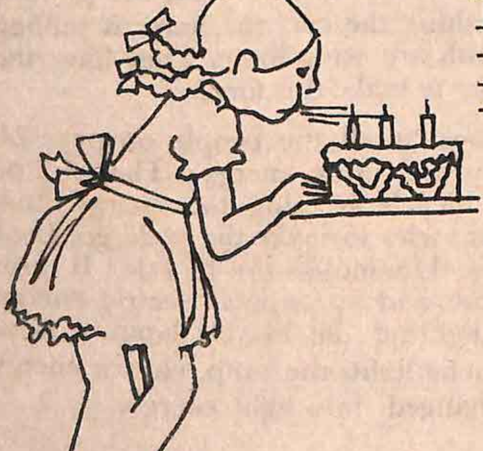
Now let us look more closely at the word 'energy'. Energy is the ability to use force to do things. For any kind of movement or work, some force is always needed. People lift, carry, pull or drag things about. The man in the picture is pushing the car, the horse is pulling it. Both are using force. They have the energy to make this force.

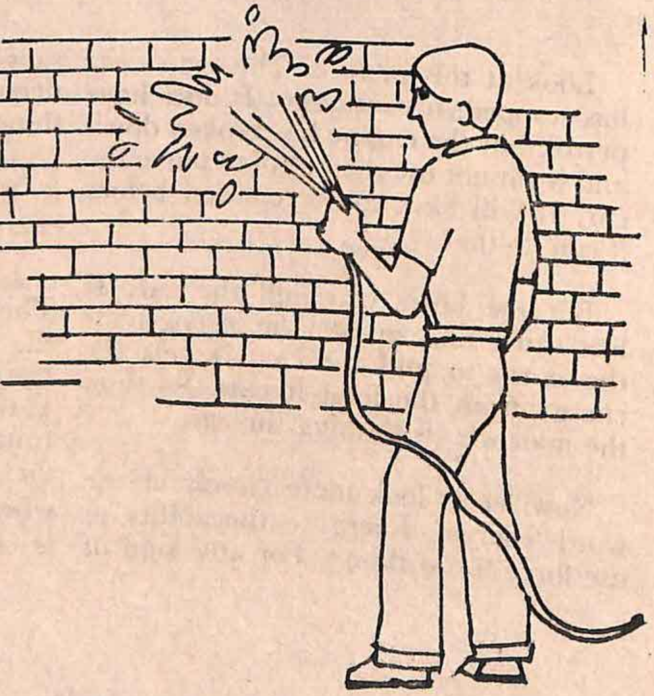
Look at all the people on page 24. They are using energy. The boy on the bicycle is using the energy from his muscles to make the cycle go. Look at the dynamo on the bicycle. It turns round and produces electric energy for lighting the bicycle lamp. Now when he lights the lamp, electric energy is changed into light energy.

Look at these pictures. What kind of energy is being used in each of them?

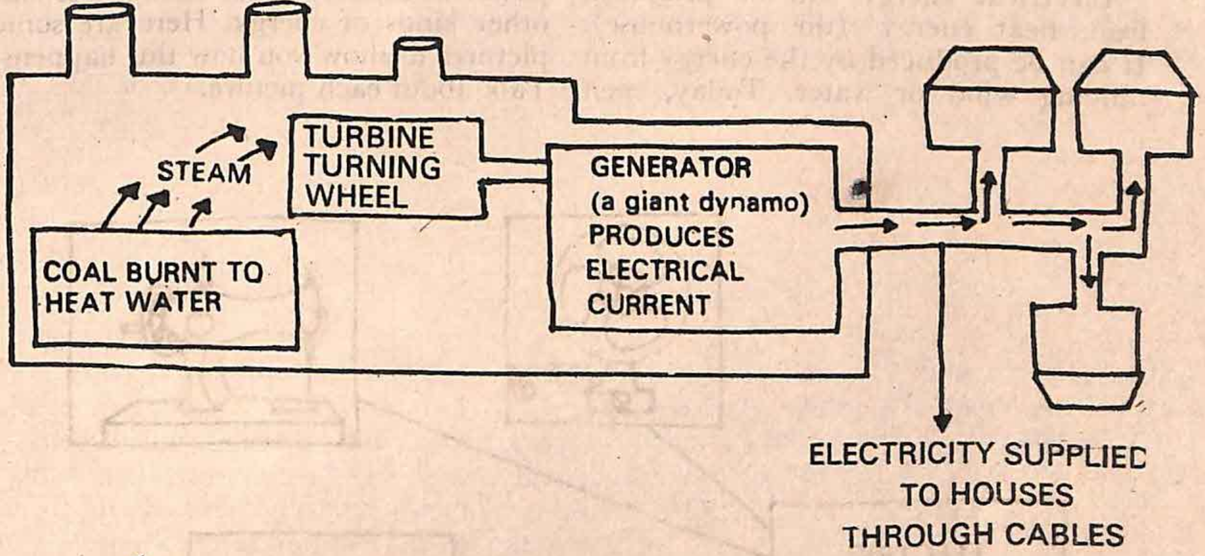


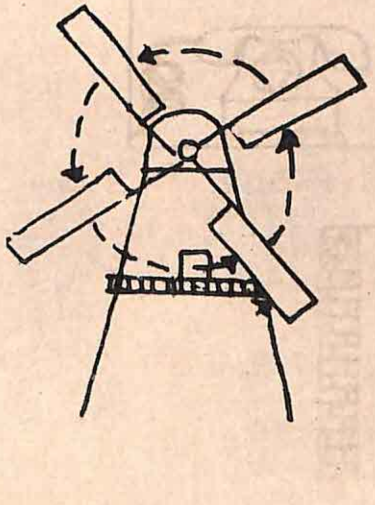






This is a powerhouse. It produces electricity or electric energy by burning coal. When coal burns we have heat energy. This is changed into electric energy to light our homes and turn our fans.


STEAM
TURBINE TURNING WHEEL
COAL BURNT TO HEAT WATER
GENERATOR (a giant dynamo) PRODUCES ELECTRICAL CURRENT
ELECTRICITY SUPPLIED TO HOUSES THROUGH CABLES



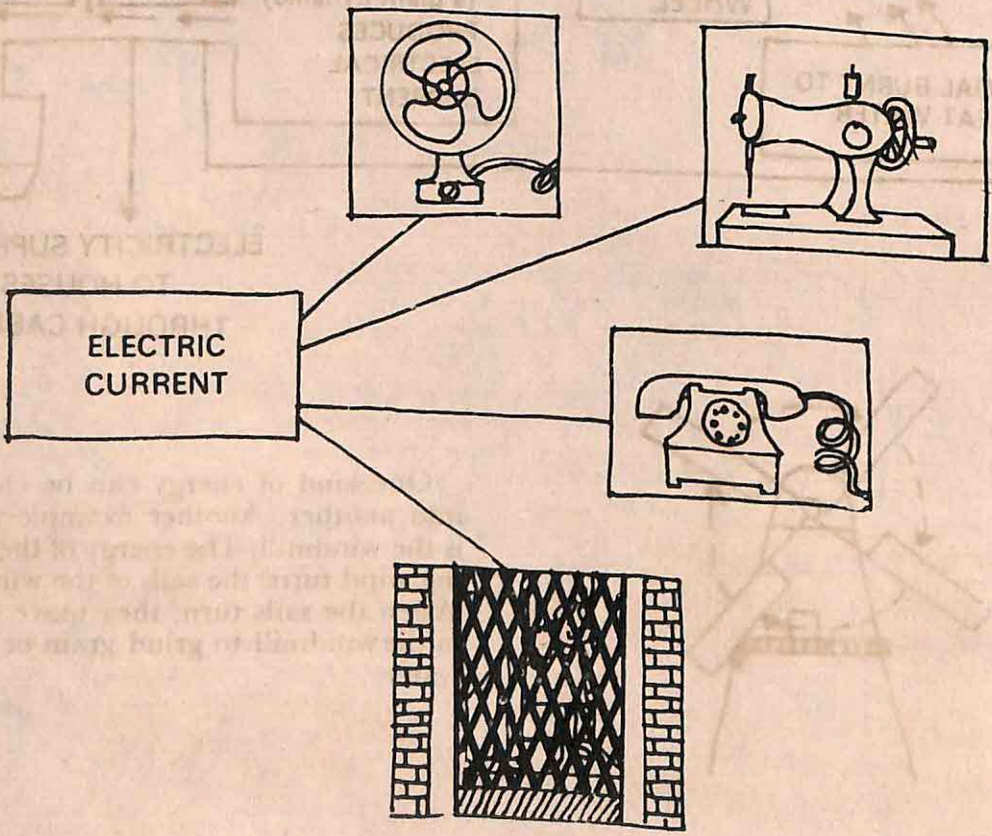
One kind of energy can be changed into another. Another example of this is the windmill. The energy of the blowing wind turns the sails of the windmill. When the sails turn, they move wheels in the windmill to grind grain or pump water.

ENERGY FROM ELECTRICITY

We have just read how one kind of energy can be used to produce another. Electricity is an energy which is produced from other kinds of energy.

Electrical energy can be produced from heat energy (the powerhouse). It can be produced by the energy from moving wind or water. Today, men have found ways of using energy from the Sun to make electrical energy.

Just as we can use other energies to make electricity, electrical energy is so powerful that it can be changed to still other kinds of energy. Here are some pictures to show you how this happens. Talk about each picture.



1 What is energy?

2 What energy are you using when you lift a chair?

blow a piece of paper off the table?

3 Name three examples in which one kind of energy is changed into another.

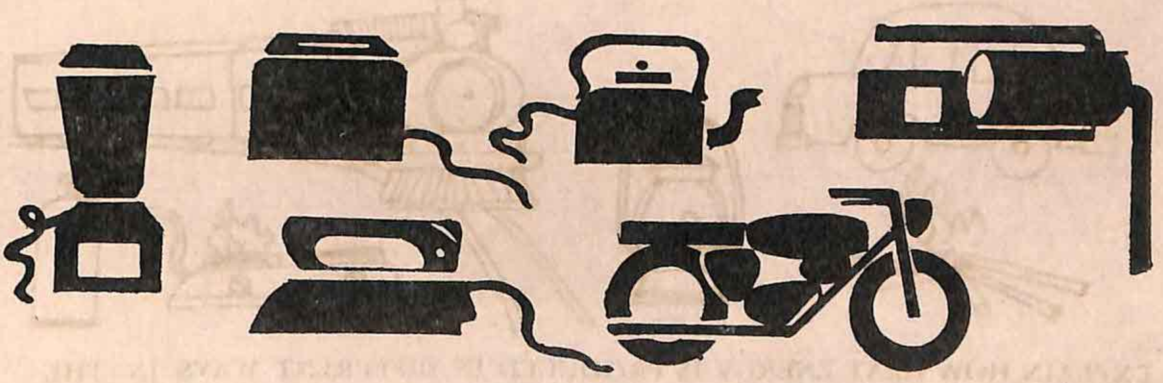
Draw a diagram to show how a windmill works. Your teacher will help you.

MOTORS

Have you seen an electric motor? **Electric trains** run on motor engines. Electric fans have motors. Electric energy moves the motor and the motor moves the fan. By turning round, the fan creates wind energy, yet another kind of energy.

Motors are used in all kinds of places. They help run cars. They pump water from wells. They run machines in factories. Motors make things move. This movement energy is called mechanical energy.

Which of these objects is motor-run?



ENERGY FROM THE SUN

There can be no life on Earth without the Sun. The Sun is a very great source of heat energy. Every day we get a great deal of heat from the Sun. Without it the Earth would be a cold planet like the Moon.

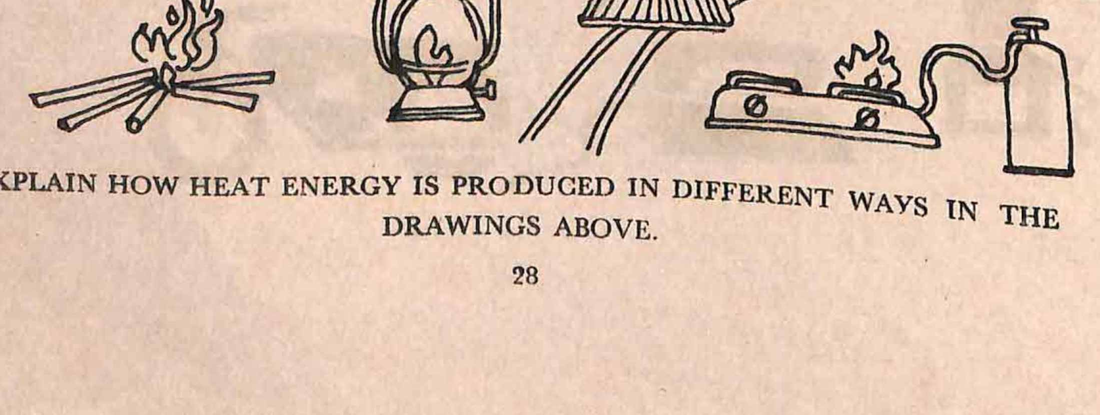
You have learnt how the Sun makes it possible for us to have rain. Water evaporates with the heat of the Sun and becomes water vapour. The vapour rises to form clouds of tiny drops of water. When the clouds touch cold air, the vapour condenses into water and falls to the Earth as rain.

When you are older and can understand these things, you will learn how water and wind also get their energy from the Sun. This energy is called *solar energy*. Today men have learnt how to use solar energy.

ENERGY FROM FUEL

When we light a kerosene stove, we are burning kerosene to make heat energy. Things like kerosene which are burnt to give heat energy are called *fuels*.

There are solid as well as liquid fuels. Can you say what fuels are used here?



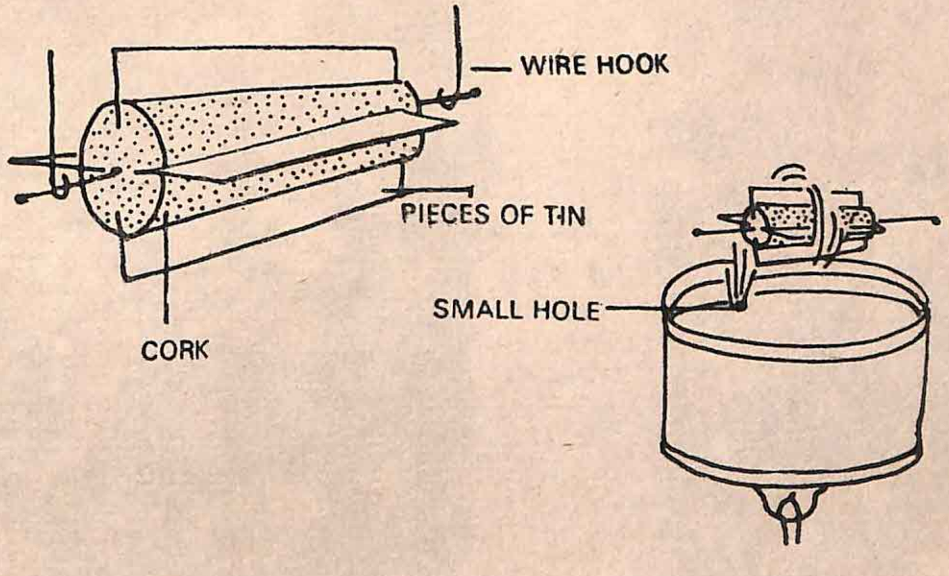
EXPLAIN HOW HEAT ENERGY IS PRODUCED IN DIFFERENT WAYS IN THE DRAWINGS ABOVE.

1 What is a motor?

2 What is solar energy?

3 What kind of energy is solar energy?

Make a waterwheel for your class. You will need a cylindrical piece of cork or an empty thread reel, small wedges of tin, wire to make a hook and a jug of water. The picture shows you how to make the wheel and how to make it turn. The force of the water provides energy to turn the wheel. On the right is a picture of a steam-driven wheel.

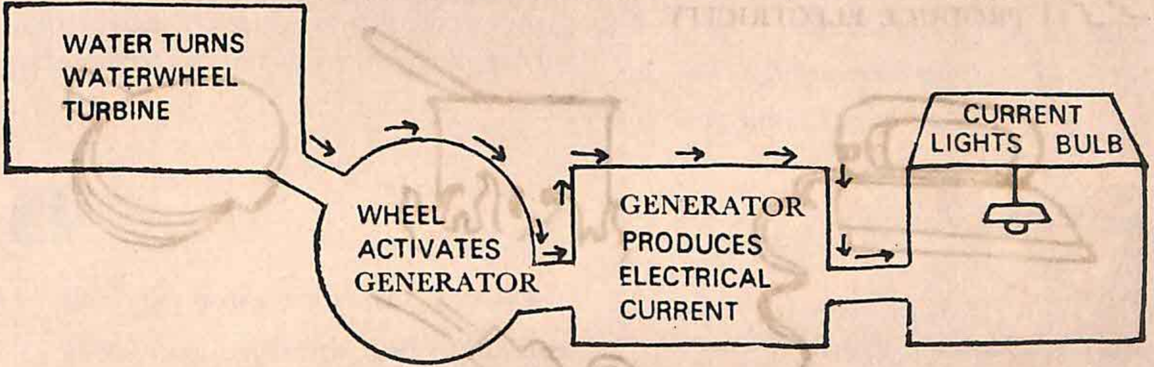


ELECTRICITY FROM WATER

Water flowing with force can be used to produce electricity. The forceful flow of waterfalls may be used for this purpose. In many parts of

India, rivers have been dammed, or held up by a wall. The water is then released when needed and made to flow with such force that it can turn giant waterwheels. You have just seen how a waterwheel works. The waterwheel is used to turn a **generator** to produce electrical energy.

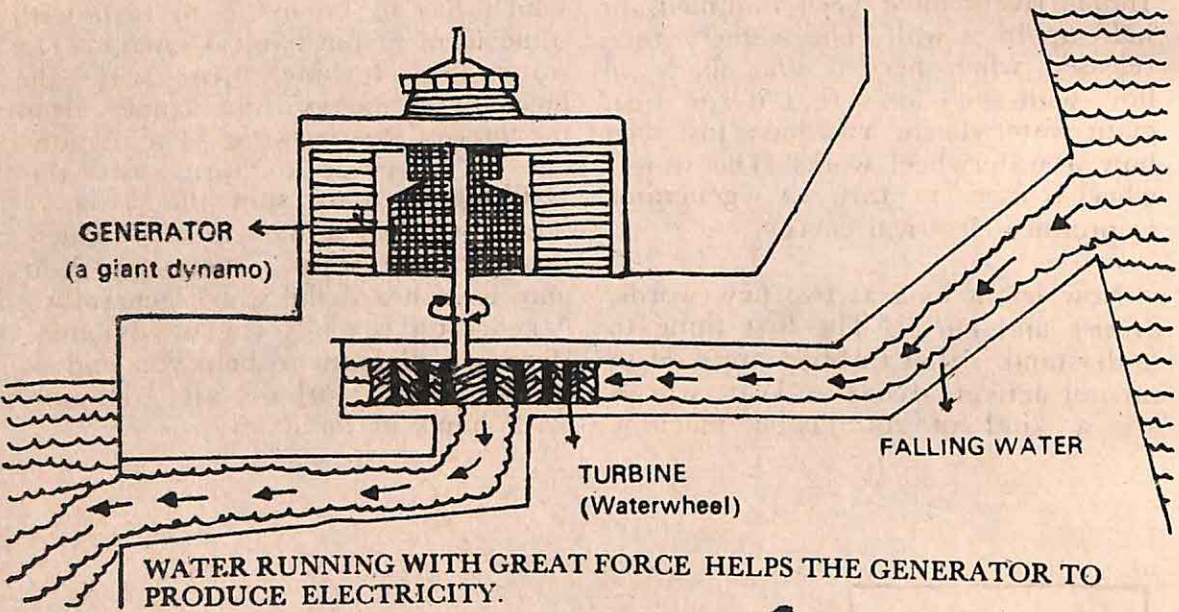
Now let us look at two new words, *dynamo* and *turbine*. The first thing to understand is that turbines are used to turn or activate dynamos. Waterwheels are a kind of turbine, a machine which has to be made to turn with some form of mechanical energy. The waterwheel turbine turns with the mechanical energy that comes from the force of flowing water. The turbine, once it is made to turn, uses **the resulting** force to **spin** the dynamo. This sets up a movement which produces electrical energy. You may have heard the word 'generator'. A generator is really a giant dynamo. Here is a diagram to help you understand how a turbine and dynamo work hand in hand.


WATER TURNS WATERWHEEL TURBINE
WHEEL ACTIVATES GENERATOR
GENERATOR PRODUCES ELECTRICAL CURRENT
CURRENT LIGHTS BULB

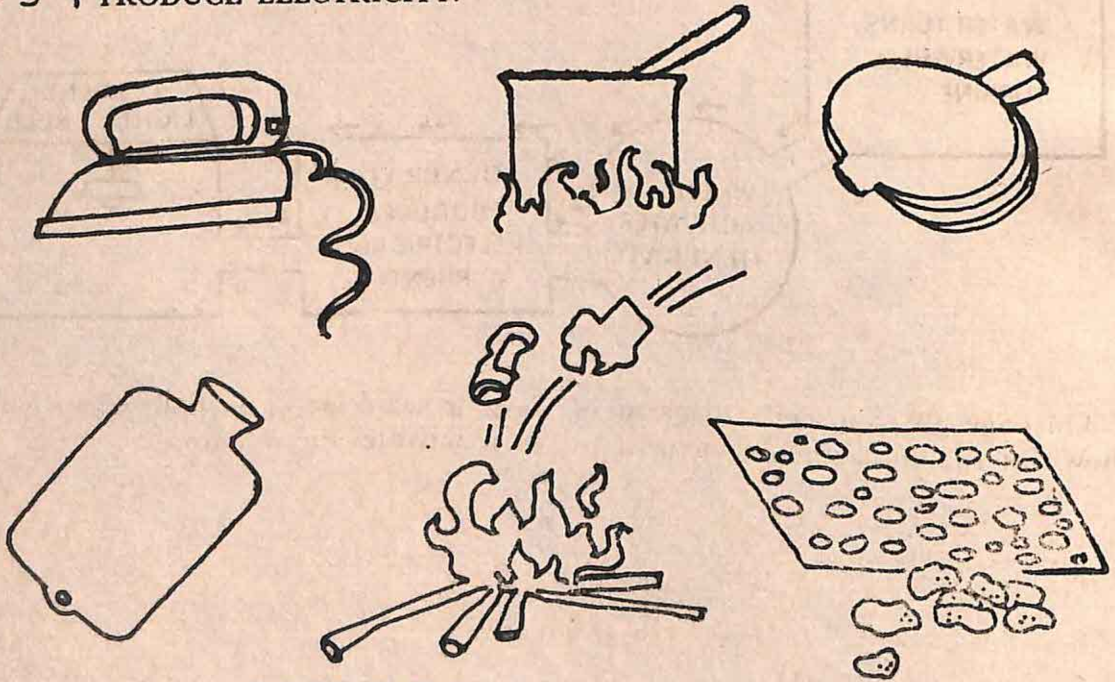
On page 32, you see a diagram of how water falling with force is used to turn a waterwheel turbine which in turn activates the dynamo.

HEAT ENERGY

Heat is a form of energy. We use it to produce steam or hot gases to run engines and for various everyday purposes. If you try to think of it, heat



WATER RUNNING WITH GREAT FORCE HELPS THE GENERATOR TO PRODUCE ELECTRICITY.



WHAT KIND OF ENERGY IS USED IN EACH OF THE EXAMPLES ABOVE ?

is used in countless ways and has become such a necessary part of our daily lives that we cannot do without it. When you cook, you use the energy from heat to cook the food. A steam engine runs **on** the force of hot steam and this steam is made by burning coal and heating water to produce steam.

In industry heat is used for melting and moulding metals, for creating electricity, moving machines, welding and for hundreds of other purposes.

We get heat from the Sun. We get it from fuels like wood, coal, kerosene oil and petrol. We also get it from an important energy in our daily lives: electricity.

1 Describe how a waterwheel works.

2 What are turbines and dynamos, and how are they linked together?

3 Write how heat is produced in each of these cases:

The heating of the Earth after it has become cold.
Cooking.
Steam engines.
Making bricks.
Welding metals.
Running a car.
Producing electrical energy.

4 Fill in the blanks:

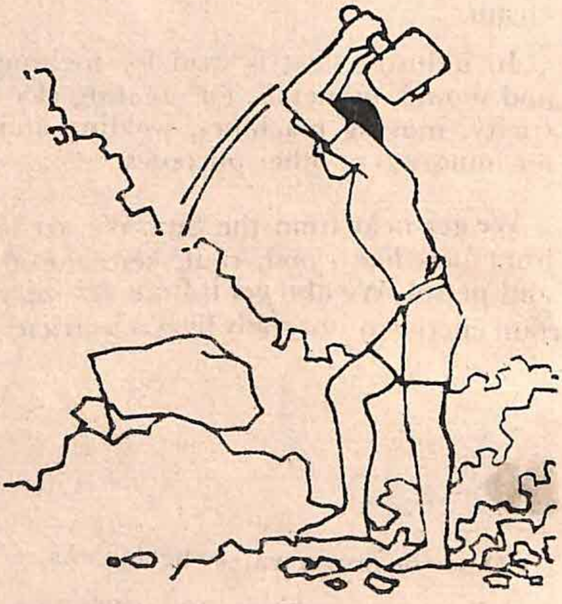
a A push or a pull is called a ——.
b Materials or substances which produce heat when they burn are called ——.
c —— is needed to do work.
d —— gives us energy to do work.
e Our main source of energy is ——.

5 Name 5 ways in which heat energy is useful to us.

6 Fill in the blanks:
——— energy is used for riding on a cycle.

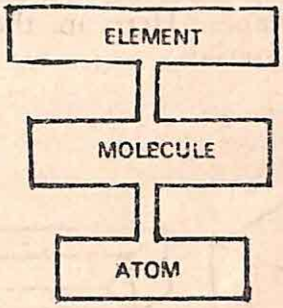
4 MATERIALS AND THEIR PROPERTIES

This man is breaking a stone into smaller pieces with his hammer. If he works at it long, he can make a coarse powder of it. He can, in other words, break it into smaller particles. A machine could mill it into even finer particles and make a fine powder of it. Some of the grains of this powder will be so fine that you can see them only through a magnifying lens. Even these grains are made of tinier particles that cannot be seen even with the most powerful microscope.



We will understand the world of things we hear, see, touch, smell and feel better if we look at it as a world made up of substances. Scientists also call these *elements*. There are 105 different elements of which the universe is made. Everything we see around us or know about is made up of combinations of these elements. Each of these elements contains smaller parts of it which are called *molecules*. A molecule is the smallest part of a substance which can exist on its own. When you taste the sugar in your tea, you are tasting the sugar molecules that touch your tongue. Molecules of smells of various kinds may mix with the gases in the air, and some of these reach your nose. When you smell a substance—say, an onion—you are sensing some of its molecules by means of smell.

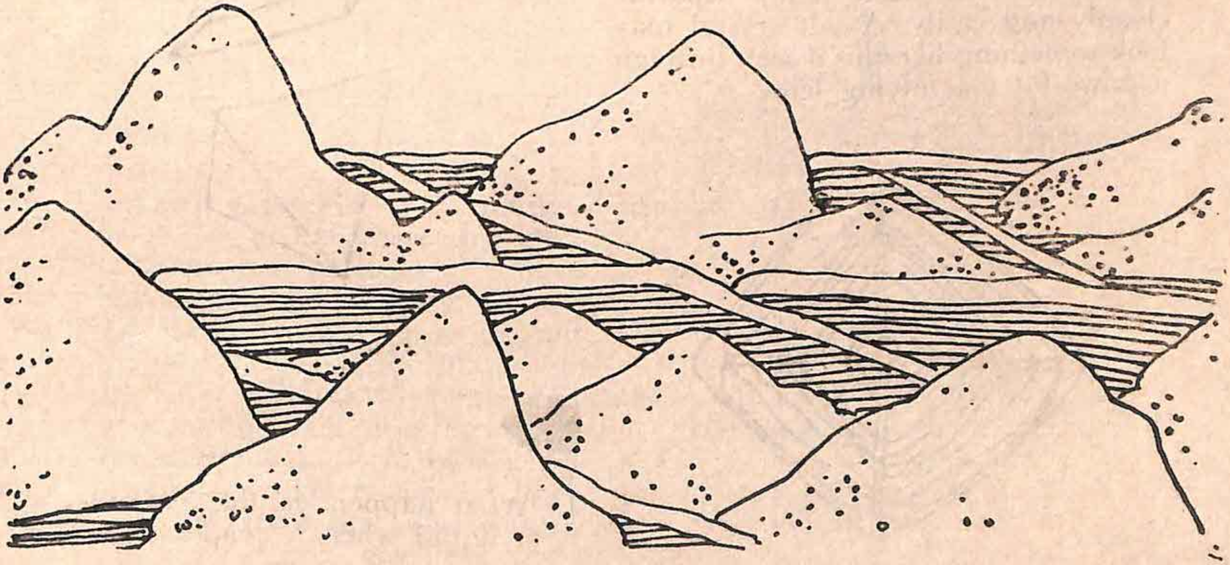
Every molecule of a particular subtance consists of one or more particles called *atoms*. The molecules of some substances consist of only one atom—iron is one of these. Others may consist of two or more atoms. Each molecule of sugar consists of as many as 45 atoms. Some molecules have hundreds, even millions of atoms in them.



Although we cannot see them, the molecules of various substances are in the air around us. We have just read how smell molecules reach us. There is another event that is happening all the time—evaporation. The smallest particles on the surface of the water move out of the water into the air. Heat helps the molecules to rise. That is why on a hot day, your clothes dry quickly. The sunlight causes the water particles to move from the surfaces of the clothes into the air.

Heat helps by separating the particles and making them lighter. The more heat you have, the greater the separation of particles. If you place a vessel of water over the fire, the fire heats the water until it boils. At this point the heat separates the particles so much that they rise quickly into the air. You can see them go up in the form of steam. If you increase the heat, the water evaporates even more quickly. And if you leave the vessel on the fire, the water will finally dry up completely and there will be none left in the vessel.

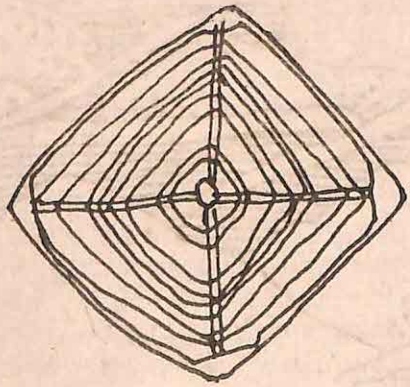
This is a picture of a salt pan. We find them near the sea in the backwaters. Sea water, as you know, contains salt. A field is prepared near the



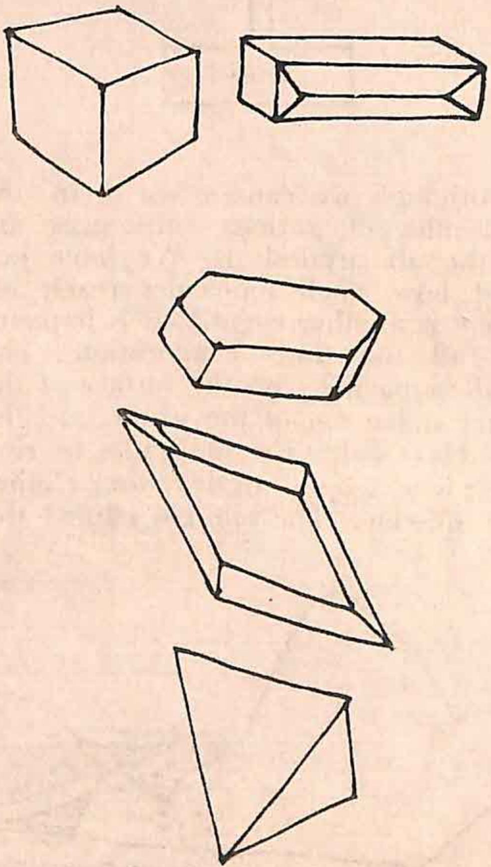
sea, and the water is made to flow into the field. The field is then divided into smaller parts with the help of low walls of soil. The sea water is now trapped in each small field, and is allowed to remain there. The strong sun causes all the water to evaporate, and only the heaps of salt are left behind. The grains of salt are then cleaned, and sold. We call the grains salt *crystals*.

Let us now take a look at crystals. Many substances have grains which have a definite shape. All the grains of that substance will have that shape. We call these crystals. Crystal grains are pure. They do not have any impurities in them.

Take a very small solution of strong salt. Keep the solution in a shallow glass dish, and let it remain there for a few days. The water will have dried up, and you have a heap of salt crystals in the dish. They separate cleanly and easily. A salt crystal may look something like this if seen through a powerful magnifying lens.



Crystals of different materials have different shapes. Here are the crystals of some materials:



1 What happens to the molecules of a liquid when it evaporates?

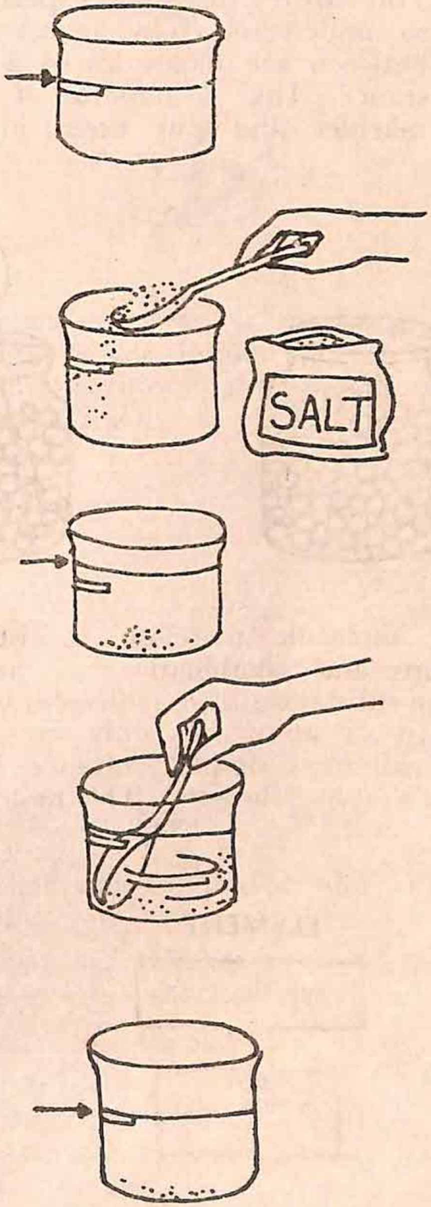
2 How does heat help evaporation?

3 Describe one method of obtaining salt from sea water.

4 What are crystals and what qualities do they have? Name five substances which have crystal grains.

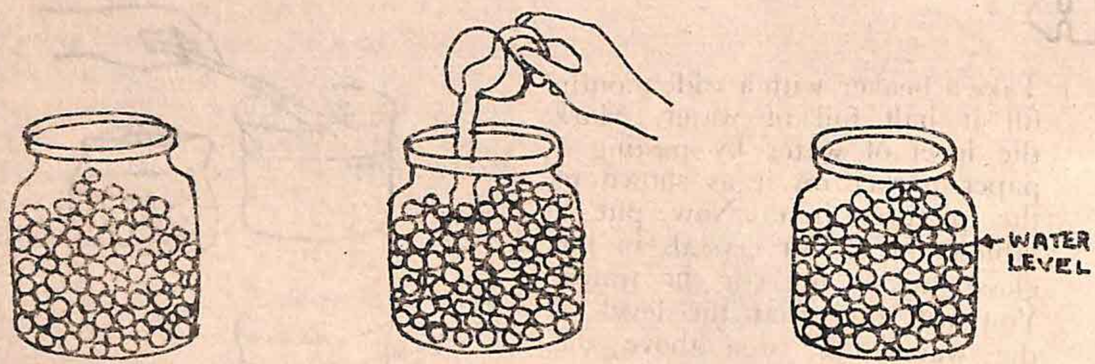
1 Take a beaker with a wide mouth, fill it half full of water. Mark the level of water by pasting a paper-marker on it as shown in the pictures here. Now put a tablespoon of salt crystals in the glass, but do not stir the water. You will find that the level of the water has risen above the paper-mark. This is because a new substance has been added. Now stir the liquid well until all the salt dissolves. What do you see now? You will probably see that the water level has dropped once again to the paper-mark level.

The explanation for this is found in the fact that there are *spaces* between the particles of water. Solids cannot of course, fill this space, so when you put in the salt, the water level rises. But when the salt dissolves, the molecules spread and fill in the spaces between the molecules of water. The space that is already there is being filled up. This is why, when you dissolve a solid in a liquid completely, you will find that there is practically no increase



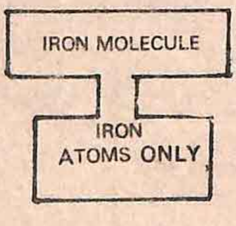
in volume or quantity. You can try this experiment the next time you have a cup of tea.

2 You can try this small experiment to understand how spaces exist between the molecules of a substance. Take a handful of glass marbles and put them into a broad-necked bottle. Pour a little water slowly into the bottle. You will see that the water fills up the spaces between the marbles, but it does not come up above the level of the marbles. It will have to fill up all the spaces before it can begin to come up.

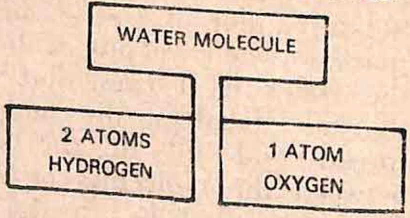


A molecule therefore consists of groups and combinations of atoms. Some substances have molecules which consist of atoms of only one kind. We call these simple substances. Iron is a simple substance. The molecules of some substances consist of more than one kind of atom. We call these compound substances. Water is a compound substance. Each water molecule consists of two atoms of hydrogen and one atom of oxygen.

ELEMENT



COMPOUND SUBSTANCE



Let us now take a look at how the molecules in substances 'behave'—how they act when mixed with the molecules of other substances. This glass contains water. Now if you put an ink tablet in it and stir it, the molecules of the tablet dissolve and spread and become a part of the water. We say the tablet has dissolved completely. There are no solid particles left in the water.

We know now that some solid substances can mix with liquids to make solutions. The molecules in the solid substance dissolve completely in the liquid. We see this happen when we mix sugar with tea, or salt with lime juice. The smaller particles dissolve first, the largest particles last. Sometimes solids dissolve more easily if they are mixed into warm or hot liquids.

Some solid and liquid substances just do not mix, no matter what you do. Think of pepper and water. The particles of pepper will float in the liquid but will not dissolve in it.

There is another interesting fact we learn about solutions. When we dissolved the ink tablet in a small glass of water, we got ink. It was a strong solution of ink. Now we can, if we wish, *dilute* this solution, or make it weaker, with more of the liquid and less of the solid. The molecules of the ink substance distribute themselves very much more if we mix a few drops of the ink in another container of water. We have diluted the ink, and the molecules are spread out over a greater quantity of the liquid. This is why the blueness shows lighter now than in the first solution.

1 What are molecules and atoms?

2 What do molecules consist of?

3 What are compound and simple subtances?

4 What action takes place when we dissolve a solid in a liquid?

5 Fill in the blanks:

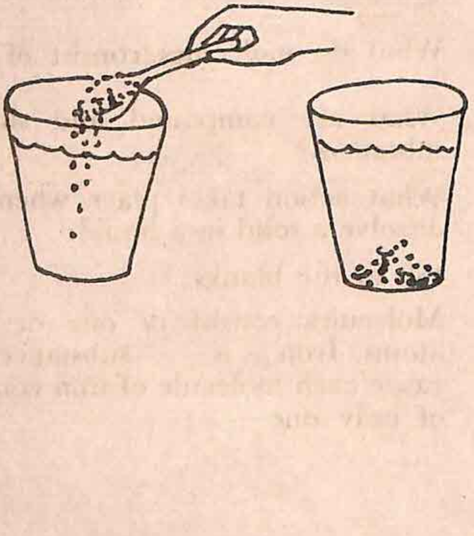
Molecules consist of one or —— atoms. Iron is a —— substance because each molecule of iron consists of only one ——.

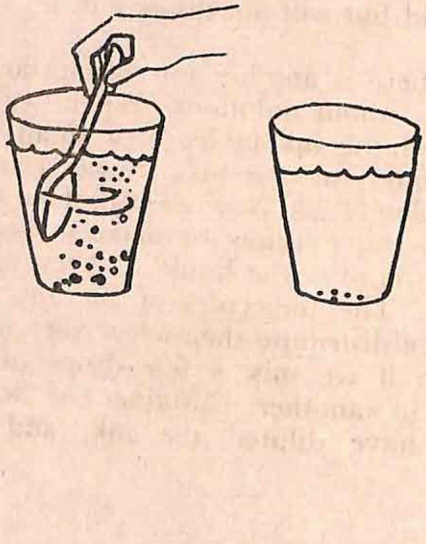
1 Take the powders of a number of things you can find easily—coffee, cleaning powder, salt, flour, ground pepper. Spread a teaspoon of each of the powders on a piece of paper. Examine each powder under a magnifying lens. Make a note of how large the particles are, whether there is any difference between the sizes of the particles of one powder and another. Observe the shapes of the particles.

2 Take a glass jar and fill it with mothballs. Keep the balls in the jar for about half an hour, then take them out. Smell the jar. What is 'left' behind in the jar?

3 Get about four glasses of water. Take a teaspoon each of coffee, talcum powder, salt and sugar. Put one of these into each glass. Observe what happens to the powders. Do they float, sink to the bottom, change the colour of the water in any way? Write down what you see. Now take a teaspoon and stir the liquid in each glass. Again write down what you see—do the water and the powders mix now? Which of them do not? Now arrange for a flask of hot water, and try out the same experiment using hot water this time. Which of the liquids make solutions and which do not?

4 Get a few crystals of potassium permanganate. Put them in water, and watch what happens. Heat the water gently and see how the potassium permanganate dissolves.

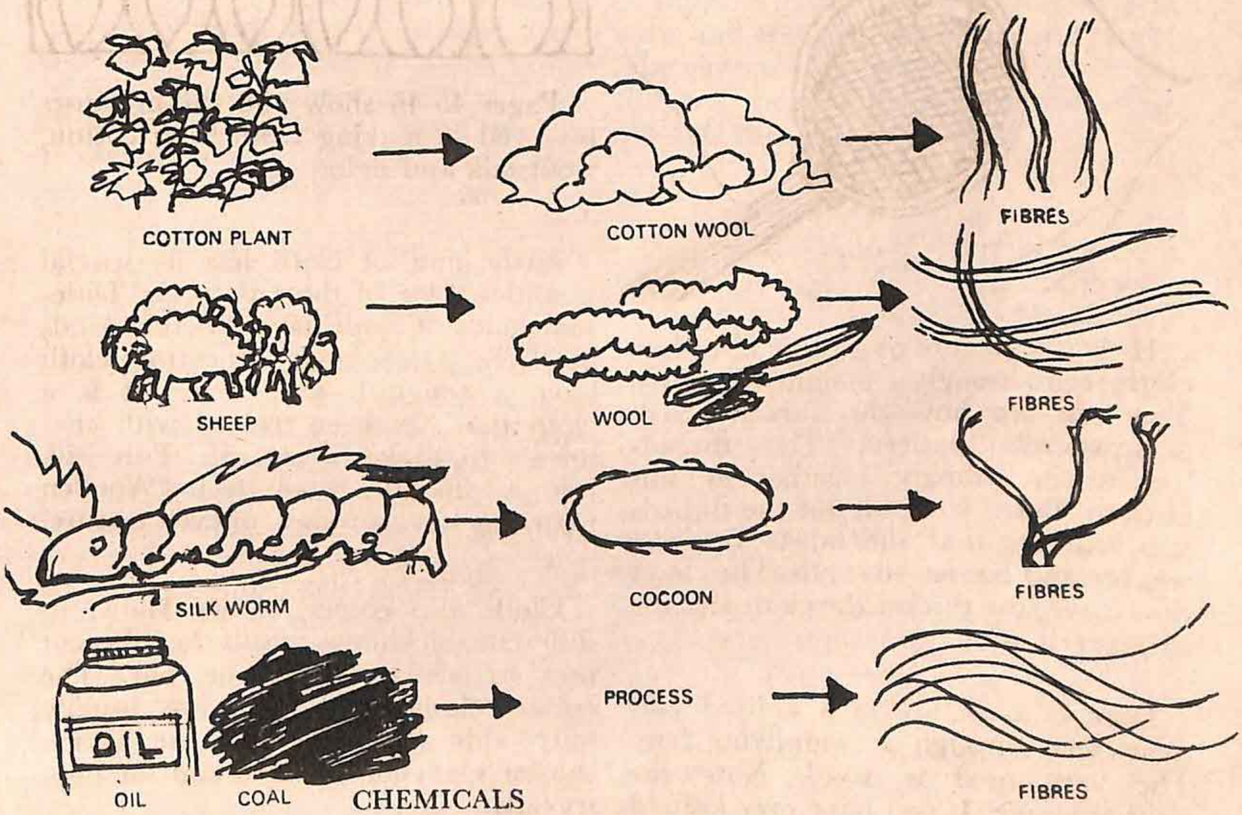




5 FIBRES FOR CLOTH

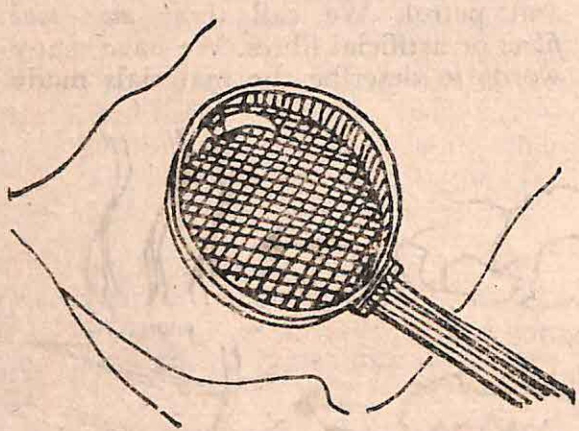
The things we need to make cloth come from many different things. We make cotton cloth from the fibres of cotton. Cotton fibre is a *natural fibre* because it comes from a plant, from nature. Wool is also a natural fibre. We get wool mainly from sheep.

Not all the fibres we use for cloth, are made from natural fibres. Men have found that you can make fibre from chemicals you get from coal and petrol. We call these *man-made fibres* or artificial fibres. We have many words to describe the materials made



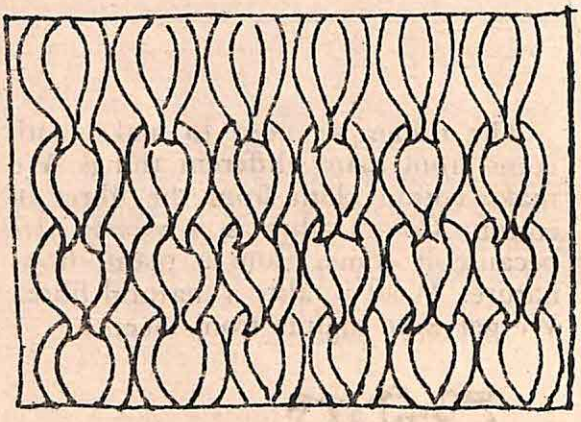
from these artificial fibres—nylon, terylene, polyester.

Before they are made into cloth all fibres must be made fit for weaving. Natural and man-made fibres go through different processes for this purpose. They are spun into thread or yarn of different thicknesses depending on what kind of cloth you want to have. The yarn is then woven by hand-looms or machine looms into cloth.



Here is a picture of a piece of cotton cloth seen through a magnifying glass. You can see how the threads have a criss-cross pattern. The threads are woven strongly together in this pattern. But if you pull out the threads you will see that the fabric becomes weaker and has no strength. The closer the weave, the thicker the cloth and the stronger it is.

Here is a picture of a knitted garment seen through a magnifying lens. The yarn used is wool. Note the knitted weave. If you have ever knitted anything you will see how you can make the knitting tight or loose depending on how you knit it. If you knit it loose, you are likely to need a lot more wool.



Pages 45-46 show you the processes involved in making cloth from cotton, wool, silk and nylon yarn.

Each kind of cloth has its special qualities. One of these is *texture*. Different kinds of cloth have different kinds of 'feel'. Most kinds of cotton cloth have a roughish feel, unless it is a cloth that has been treated with chemicals to make it smooth. Pure silk has a smooth, cool feel. Woollen materials have a rough, uneven texture.

Cloth also comes, as we know, in different thicknesses to suit the different uses to which it will be put. The cotton clothes we wear are usually fairly thin and light. We use heavy, thicker cloth for curtains and for bedspreads.

The other special quality that each kind of cloth has is the quality to absorb (or not absorb) water. Most kinds of cotton cloth can absorb water and the water can be squeezed out. Wool absorbs water, but much more slowly. If you soak a woollen garment in water, you can see the drops of water clinging to the garment. Some materials made of man-made fibres do not absorb water, they repel it or keep it off. The water slides off the cloth.

If we understand the point about cloth and its quality of absorbing water, we will also understand that some fabrics can be washed, others cannot. All materials attract dirt which lodges in the spaces between the weave. But not all materials can be cleaned by washing them in water. Some can be cleaned only by 'dry' processes such as wiping with petrol.

HOW CLOTH IS MADE

As we have just seen, cloth is made from many kinds of natural and artificial fibres. These are obtained from different sources. There are, of course, many different materials, and people everywhere are looking for new materials from which cloth can be made.

The cloth types we know very well are cotton, wool, silk and the cloth made from synthetic fibres.

Cotton cloth is made from the fluffy white seed-pod we find on the cotton plant. The cotton is picked and the seeds are separated from the fluffy cotton. This process is called ginning. Ginning is normally done in the field because the cotton is too heavy to take away. The cotton now looks like raw wool.

The cotton is then packed in bales. It is then cleaned and 'carded' —that is, the shorter fibres are separated from the longer ones. The longer fibres come out of the cotton machine in the form of ropes. The fibres are now spun into yarn and the yarn is woven into cloth. The cloth is now cleaned and bleached. Some of the material is dyed and printed. It is then packed in bales.

Woollen cloth and wool

The wool is cut off carefully from the sheep. There are different kinds of wool from different breeds of sheep. The wool, when it is cut, is dirty, greasy and knotted. It goes through several cleaning and loosening-up processes before it can be woven into fabric.

The wool is first washed, then squeezed and dried. The lumps, seeds and other materials are then removed and the wool is carded to make it ready for spinning into yarn.

Silk

Silk is got from the silkworm. The silkworm spins the silk around itself in the form of a cocoon.

The silk cocoons are then placed in hot water. This softens the silk and makes it easier to remove. Machines are used to brush the silk more. The fibres are then held by hand and removed. A number of threads are brought together to make a single, strong thread.

Before it is made into cloth, the silk is soaked in oil or in a soap solution to soften the thread. The thread is now ready for making into cloth.

Cloth from Man-made fibres

Man-made fibres are made from oil or petrol to which chemicals are added. This results in a kind of plastic called polymers. The polymers are then converted into threads by passing them through tiny holes.

Man-made fibres are stronger than natural fibres. They do not rot and can resist insects. They are also waterproof. But synthetic materials have a surface that makes it difficult to dye them and print on them. They have to be treated with certain chemicals before this is done.

The well-known polymers used for fibres are polyesters and acrylics.

Cloth is made in such a way that the clothes we make out of them serve different purposes and have different qualities. Cotton is a 'cool' cloth. It absorbs the sweat off our bodies. It does not attract heat. Most people like, for this reason, to wear cotton clothes in summer. But in a cold winter, cotton clothes are not sufficient. We wear wool and silk instead. Both wool and silk have the quality of trapping the heat of the body in its weave, and of preventing the heat from escaping through the spaces between the weave.

Clothes made of different materials are made with climates in mind. But they must serve other purposes as well. People, when they first made cloth of different materials, soon found that they had to 'build in' other features also into these cloths. They must be hard-wearing, that is, they must not tear easily. It should be possible to clean them without much trouble and without spending a lot of money. Clothes must need as little attention as possible, so that we can spend our time doing other things which are much more important than cleaning washing and ironing! When men first realised this, they began to think of 'easy-care' materials. They could not change the real or natural qualities of plant and animal fibres. No matter what you do, cotton remains a hot-weather cloth, it crushes easily and needs to be ironed. But you *can* improve the service that cotton material can give by mixing it with a fibre that has the qualities that cotton does not have. So today we have all kinds of fabric blends or mixes. We have polyester-cotton cloth which is a blend of man-made and natural fibres. It has the coolness of cotton, but can be washed easily and needs very little ironing. We have mixtures of wool and nylon fibres, so that woollen garments can be washed more easily and will dry more quickly.

1 What are natural fibres and how are they different from man-made fibres?

2 What must we make of the fibres before they are woven into material or knitted?

3 Why does a loosely knitted woollen garment need more wool than a tightly knitted one?

4 What are the special qualities that cloth has? Why do we look for these qualities when we buy cloth or clothes?

5 What is 'dry' cleaning and why do some materials have to be dry-cleaned?

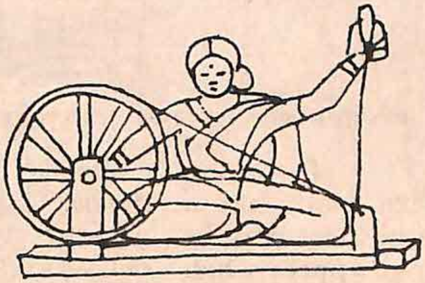
6 Describe the process of making cloth from cotton.

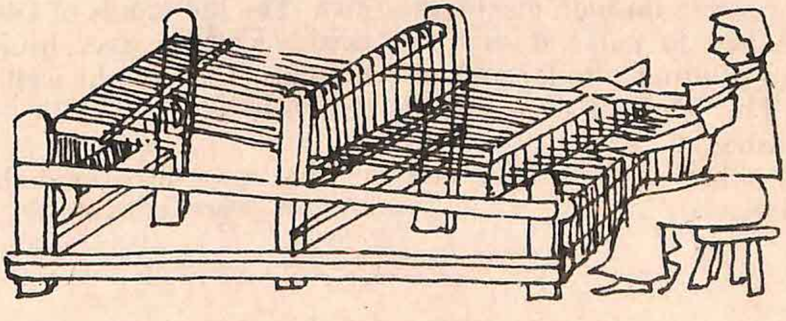
7 Why do we have fabric blends or mixes?

WEAVING CLOTH

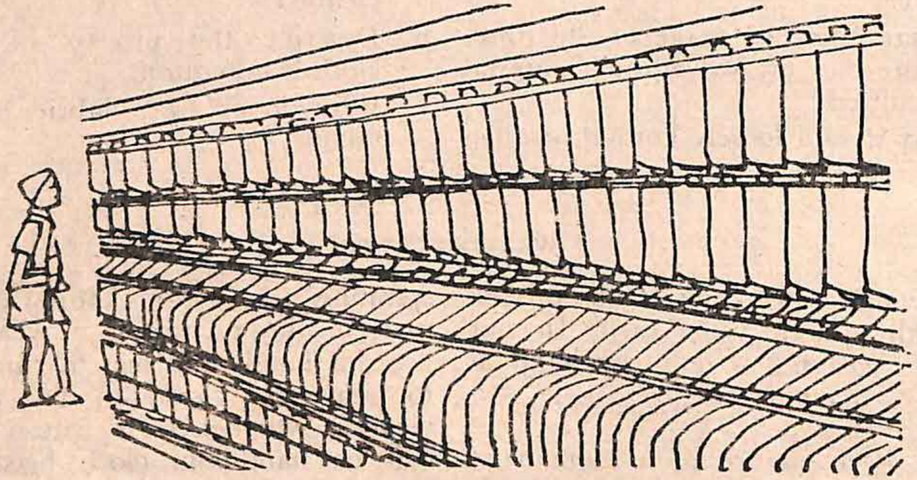
Weaving, as we know, is the process of making cloth from yarn. In our country, weaving is done by hand as well as by machines.

Here is a picture of a woman at her spinning wheel or *charkha*. She is spinning the cotton into yarn. The man in the picture is a weaver. He uses his hands and feet to run a loom to weave the cloth on. The cloth he weaves, whether it is cotton or silk, will be handloom cloth because the loom is moved with the hands.





Cloth is also spun on motor-driven spinning machines. We have power-looms and machines to weave, finish and fold the cloth into huge bales. Cloth is made here in large quantities and is sent all over the country. Cloth mills employ thousands of people, many of them to work the machines.



BLEACHING, DYEING AND PRINTING

Bleaching is the process of making cloth white. Unbleached cloth has a brownish appearance and there may be flecks of other stains which appear when the fibres are passing through machines. Cloth is bleached to make it suitable for dyeing and printing, also for making white cloth. The fabric is dipped into a solution using a chemical called chlorine. The fabric is then dried and the creases removed.

Dyeing. Men have experimented with dyeing for thousands of years. The natural fibres are usually brownish yellow and do not have a colour of their own. For thousands of years men have used vegetable dyes from plants and animals. One of the well-known plant dyes is indigo.

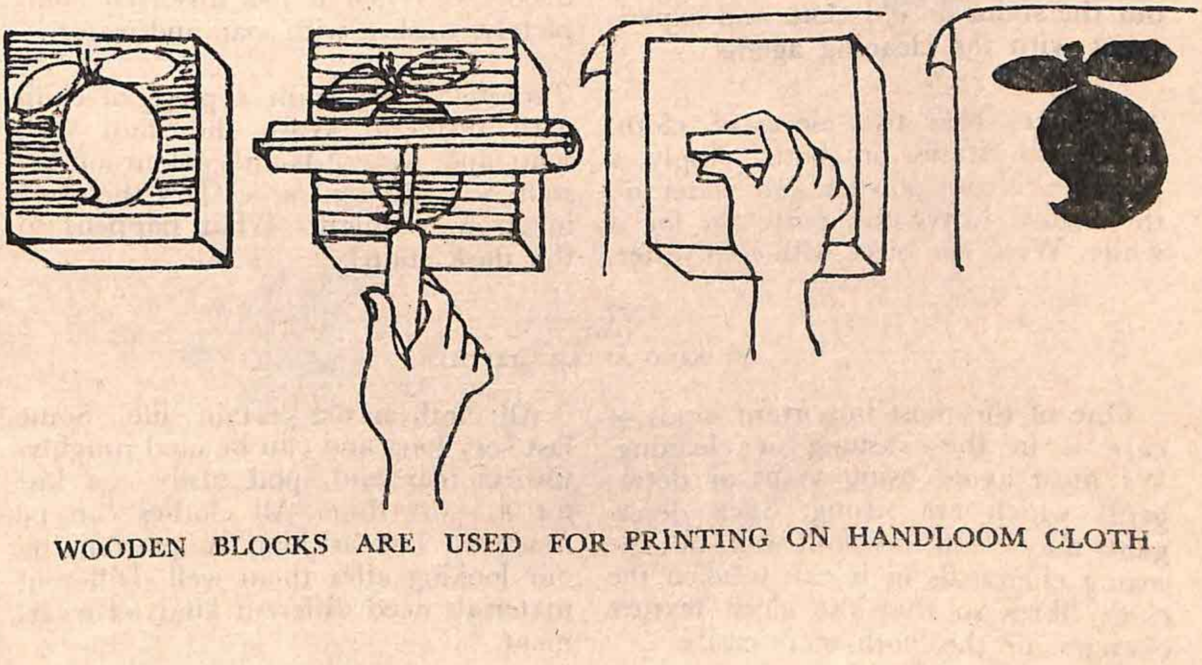
Men soon discovered that not many colours were possible from plant and animal dyes. They therefore made synthetic dyes from chemical mixtures. Because of this, literally thousands of colours have been made possible.

Different types of fibres require different types of dyeing processes. Thus dyes that can be used for cotton may not be suitable for wool or silk. Some fabrics have to be treated with chemicals to make them suitable for dyeing. This is specially true of synthetic fabrics which do not absorb colour easily.

Dyes may be fast or may 'run' and fade. A fast dye is a dye that does not fade when it is washed or sunned. The fabric (or the fibres) are dipped in the colour solution. Sometimes the solution is heated. Some dye-dipped fabrics are steamed so that the dye gets fixed.

Printing gives the material a pattern of one or more colours.

Many types of printing methods are used today. In India and some parts of the world, wood-block printing is one of the methods used. The picture shows you how this is done. Machine printing is done on a wide scale. The process is of transferring a colour pattern on to a fabric. The fabric is then steamed to fix the colour. Colour may be fixed by using chemicals called *mordents*.



WOODEN BLOCKS ARE USED FOR PRINTING ON HANDLOOM CLOTH

MARKS AND STAINS

We have just learnt how all clothes attract dust and dirt. Some kinds of dirt leave a strong mark on clothes which cannot be cleaned in the normal way. We often spill things on our clothes and the spills leave stains which are difficult to remove.

Marks and stains are left behind on materials because the fibres of the cloth absorb them immediately. The stain therefore goes deep into the cloth and is difficult to get off. We need to use cleaners that will loosen up the dirt on the fibre.

Here are some common cases of stains and marks and how they can be removed or made lighter. You can try out the stains on old cloth and experiment with the cleaning agents.

Ink stains: Take two pieces of cloth. Make ink stains on both. Apply a paste of talcum powder and water on the stains. Leave the paste on for a while. Wash one piece with cold water, the other with warm water. Which is more effective in removing the stain?

Oil stains: Put two drops of any cooking oil on a piece of cloth. Wash the cloth with warm water and soap.

Machine-oil and grease stains: Stain two pieces of cloth with machine oil or grease. Wash one with soap and water. Rub the other with cloth dipped in petrol. Find out which method removes the stain better.

Coaltar stains: Get two pieces of cloth with tar stains. Wash one with soap and hot water. Does the stain go? Put a few drops of kerosene oil on the other stain, and rub it in till the tar dissolves. When it has dissolved completely, wash it with soap and water.

Turmeric stains: Stain a piece of cloth with turmeric. Wash the stain with soap and water. Is the colour of the stain any different now? Dry the cloth in strong sunlight. What happens to the dark stain?

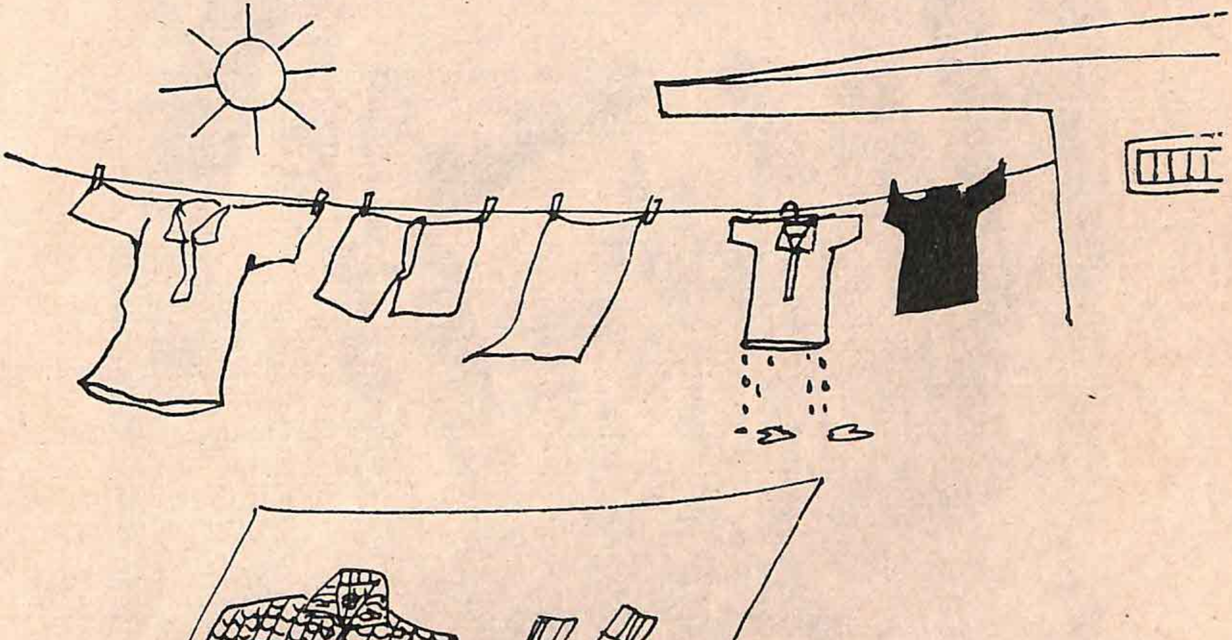
LOOKING AFTER CLOTHES

One of the most important kinds of care is in the washing or cleaning. We must avoid using soaps or detergents which are strong. Such detergents may clean the cloth well, but the strong chemicals in it can weaken the cloth fibres so that the cloth texture changes, or the cloth tears easily.

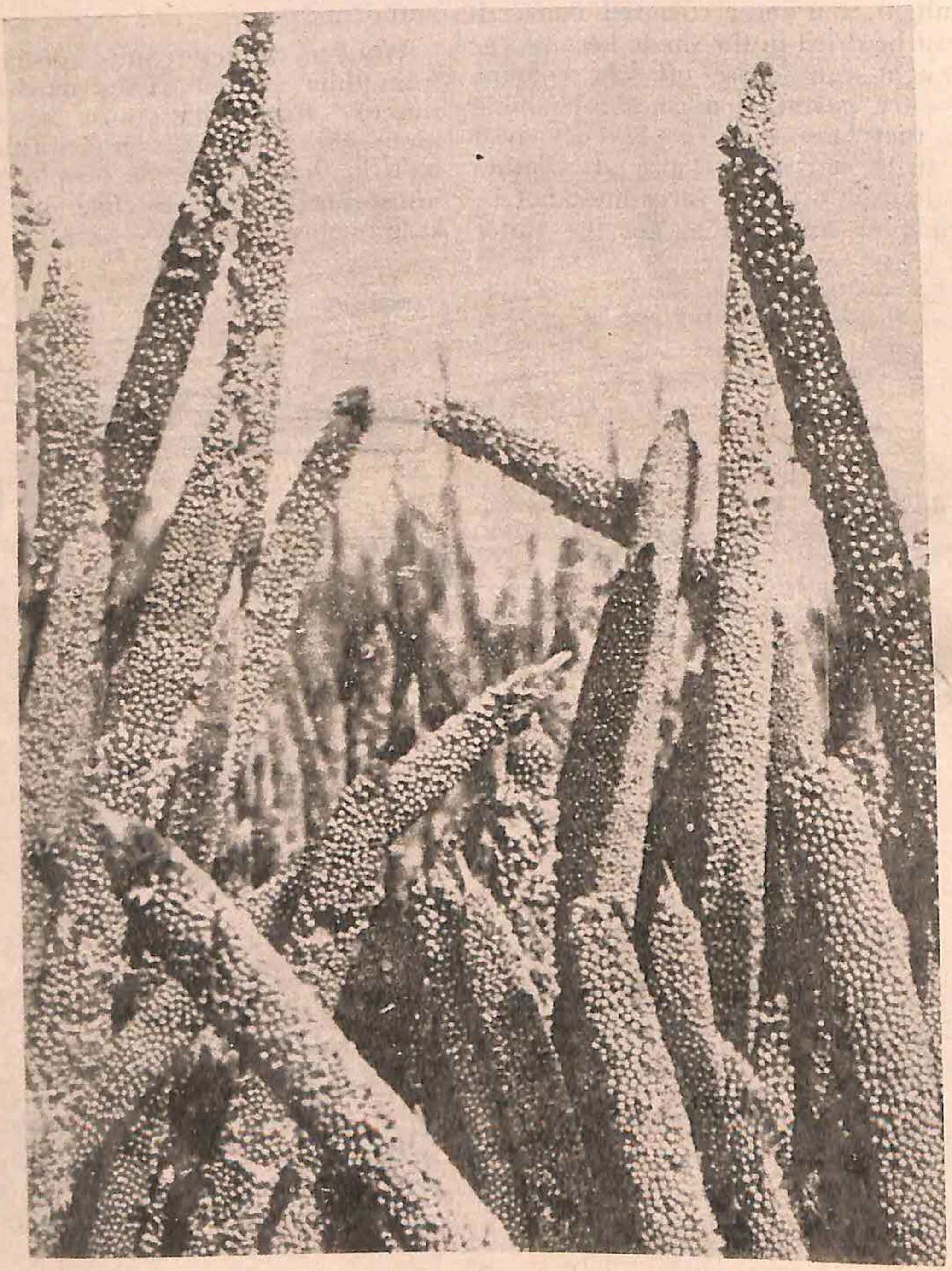
All cloth has a certain 'life'. Some last very long and can be used roughly. Others tear and spoil easily and last for a short time. All clothes can be made to last as long as possible by our looking after them well. Different materials need different kinds of treatment.

Cotton clothes can be dried in the sunlight, but most coloured materials must be dried in the shade because the sunlight can 'chase off' the colours. Woollen garments must not be hung up, they loose their shape. They must be dried flat on the ground. Clothes made from artificial yarns must not be wrung or squeezed to get the water off. They must be allowed to hang and drip dry.

Woollen clothes require special care from time to time. They need to be sunned often. They must be stored away with mothballs or naphthalene balls in the folds. Some people put in insect-repelling leaves like neem to keep the insects away.



DRYING CLOTHES



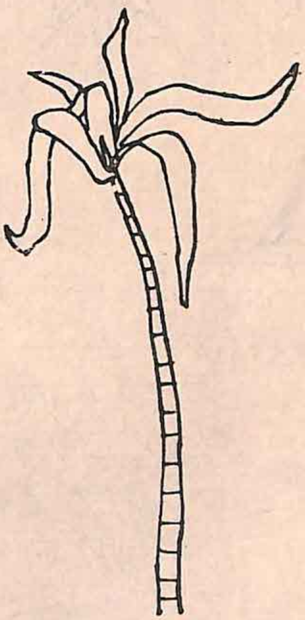
6 PLANTS IN OUR LIVES

Plants are our biggest source of food. Without them, life on Earth would come slowly but surely to an end. The first men got their food from plants and animals, and when they learnt farming they found they could grow plants in such a way that they had the food they wanted *when* they wanted it.

Strange as it may seem, grasses are our biggest source of food. Cereals like rice, wheat, barley and maize are from grasses. Rice and wheat are very important cereals to us in India. They are two of our main foods.

A lot of grasses are grown for fodder. The grass is dried and the hay is stored in bundles or stacks. Some grasses are mixed with other plant food to make fodder for animals.

The sugarcane plant is a giant grass. It is the stem which stores the juice from which we make sugar. Sugarcane is grown in many parts of India.

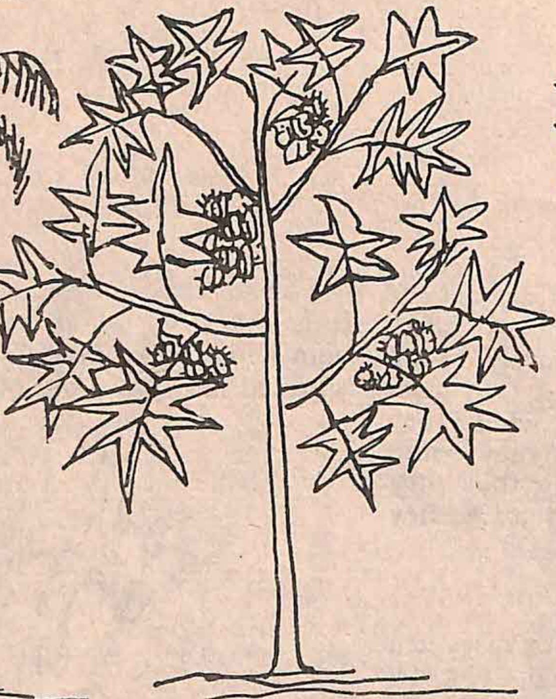


OIL FROM PLANTS

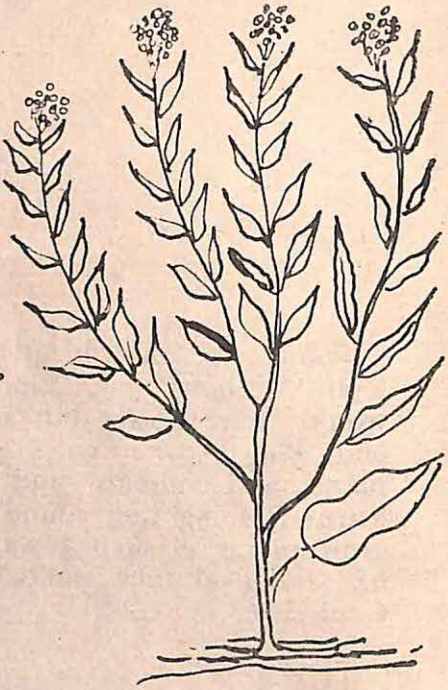
Plants are a source of many kinds of oil. We get oils from various parts of the plant. Oil is obtained by drying and crushing the oil-bearing parts and then separating the plant matter from the oil.

Get two or three big groundnut seeds. Put them into a paper envelope and pound over the paper till the nuts inside are crushed. If you open the envelope, you will see that the groundnut powder has left a trace of oil.

COCONUT

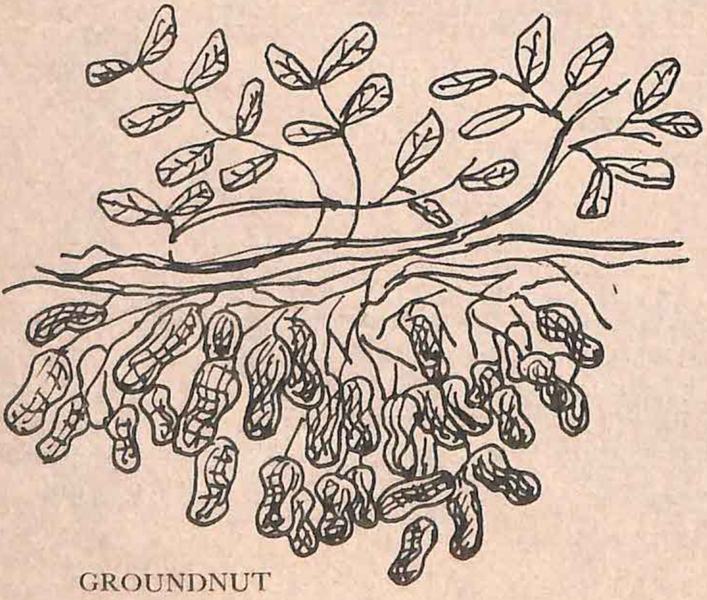


EUCALYPTUS



CASTOR

MUSTARD



GROUNDNUT

SANDALWOOD

Many plants contain oil which we use for many purposes, mainly cooking. Most oils are obtained from the seeds of plants (such as groundnuts, castor and sesame), and some are obtained by drying the fruit. The coconut is an example of this. Sandalwood oil comes from the wood of the sandalwood tree. Eucalyptus oil is made from the leaves of the blue gum tree.

The fruits or seeds of oil-bearing plants are processed in such a way that the oil is separated from the other matter. It is then cleaned of impurities. Some cooking oils are refined—that is, they go through a process of further cleaning. The process also ensures that the nutrient qualities stay in some measure.

Not all natural oils are suitable for cooking. Linseed oil is used for furniture polishes and for staining leather. Castor-oil is used as a medicine.

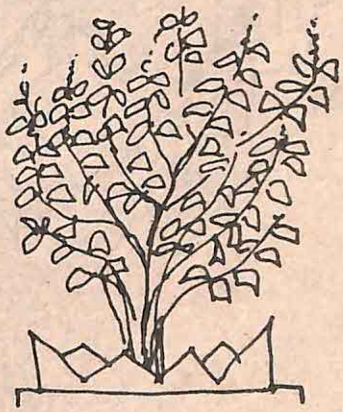
Scientists have found that some oils have a poor effect on the health if taken in large quantities. They are therefore experimenting with oils from other lesser-known plants. Sunflower oil has been found to be good for people who want to guard against heart disease.

MEDICINES FROM PLANTS

Through the centuries, men have been learning to use plants for medicine. A lot of the medicines we take today come from plants. In India, the science of *ayurveda* is based on the treatment of sickness and disease with plant medicines.

Most of us know the tulsi plant. It is used to make various kinds of medicinal teas to cure coughs and colds.

Eucalyptus is grown generally on the slopes of hills. The leaves have a strong, sharp smell. They are crushed to make eucalyptus oil. We get the oil along with the steam when we boil the leaves in water. The oil is used as a base in medicines for cold cures.

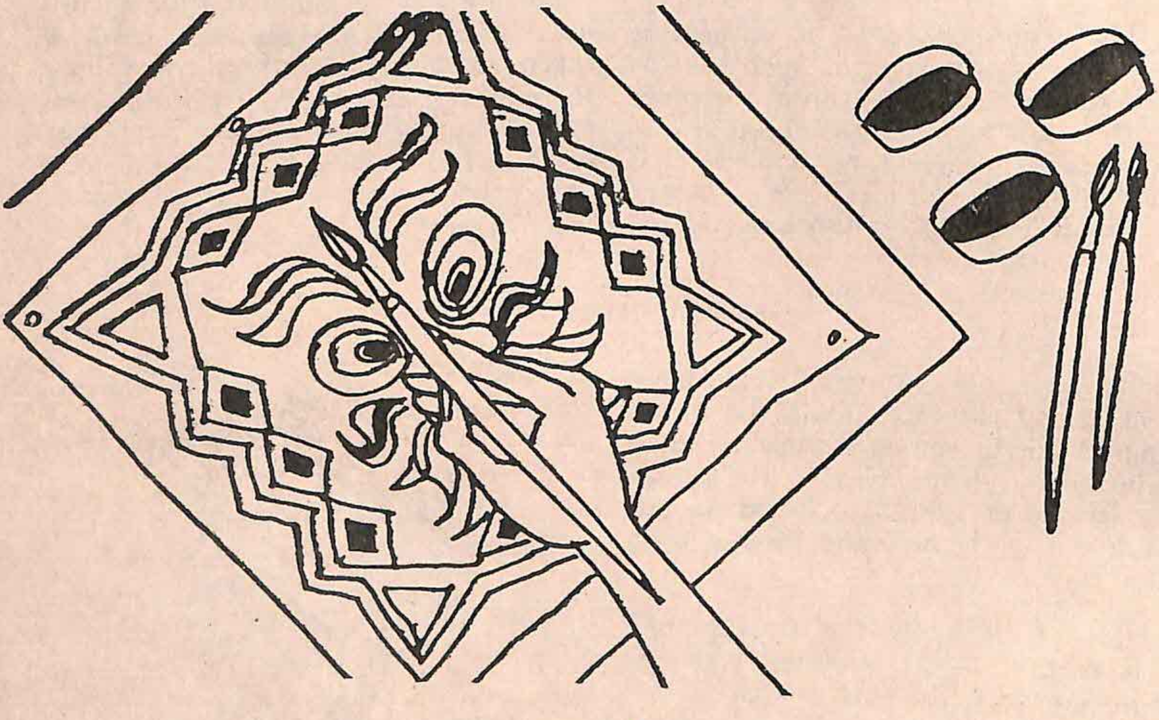


The leaves and bark of the neem tree are used for making medicinal soaps. The seeds give us a medicinal oil. The juice of the neem leaves has an antiseptic quality, that is, it can kill some germs

PLANTS FOR COLOUR

Did you know that we get colours or dyes from plants for cloth? These dyes are obtained from the leaves, fruits, seeds or roots of plants, sometimes from the stems. The dyes have to be cooked or treated with mixtures of other plant juices to be able to 'hold' the colour when they are put on cloth. Most of these plant dyes are permanent, that is, they cannot be washed away.

Here is a picture of a man painting a design on cloth. He is using a plant or vegetable dye.



1 How are grasses our biggest source of food?

2 Name six other cereals apart from rice, wheat and barley.

3 How is oil obtained from plants?

4 How are the neem and the eucalyptus used for medicines?

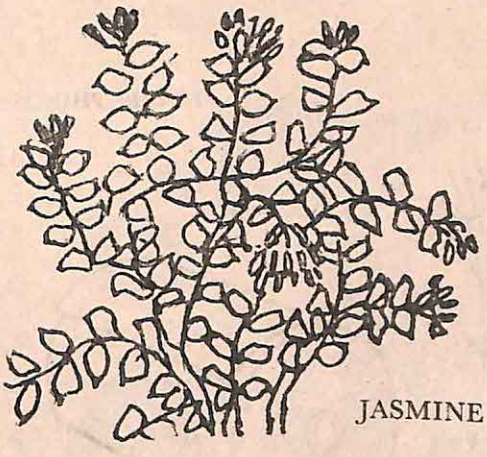
5 Draw three grasses, herbs, trees and shrubs.

6 You learnt about indigo in an earlier chapter. Is it a plant or an animal dye?

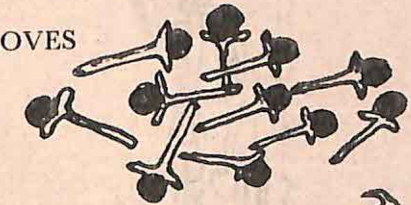
PLANTS FOR PERFUME

The flowers of many plants can be made into perfume. Here are some of the flowers we use for perfume in India. The flowers are crushed to extract the juice. This is mixed with other plant juices and with chemicals to preserve it. The liquid is then distilled, that is, it is reduced to its purest form. Sandalwood is also used to make perfume and perfumed soaps.

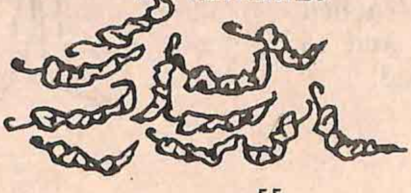
ROSES


JASMINE

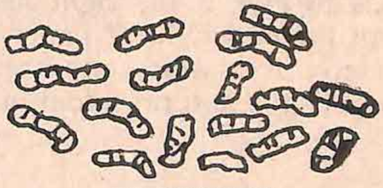
Plants are also used for flavourings and essences. Parts of the flowers of the saffron plant are dried, and when they are completely dry, they add a delicious flavour and colour to food. We also get many kinds of spices from plants. Some of us use cloves, cardamoms, pepper, chillies and turmeric in our cooking.


CLOVES

CARDAMOM


CHILLIES

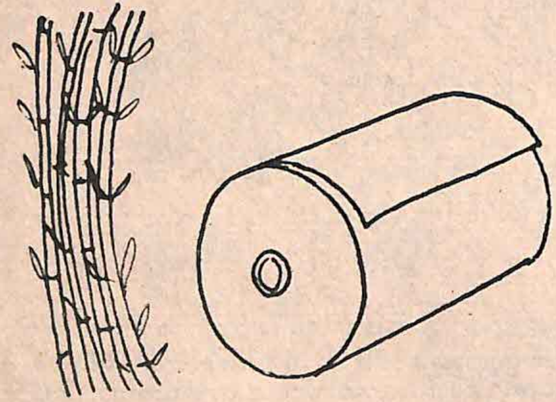
PEPPER


TURMERIC

1 The coconut and the sandalwood trees are two of our most useful trees. Make a list of the various products we get from these.
2 Make a list of as many plants as possible from which we make flavourings and essences.

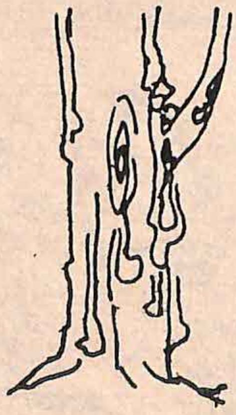
Make a classroom chart for 'Food from Plants'. Divide the chart into sections: cereals, vegetables, fruit, spices, oil, and flavourings. Collect magazine pictures of these plants under each group, or draw and paint them.

OTHER THINGS FROM PLANTS



This is a roll of paper. Did you know that paper is made from woodpulp. Among others bamboo provides some of the best kinds of woodpulp for paper. The wood is crushed and made into pulp. It is then treated with chemicals to give it the right material content for paper. Most paper is bleached to give it a white appearance and to remove the natural colour of wood.

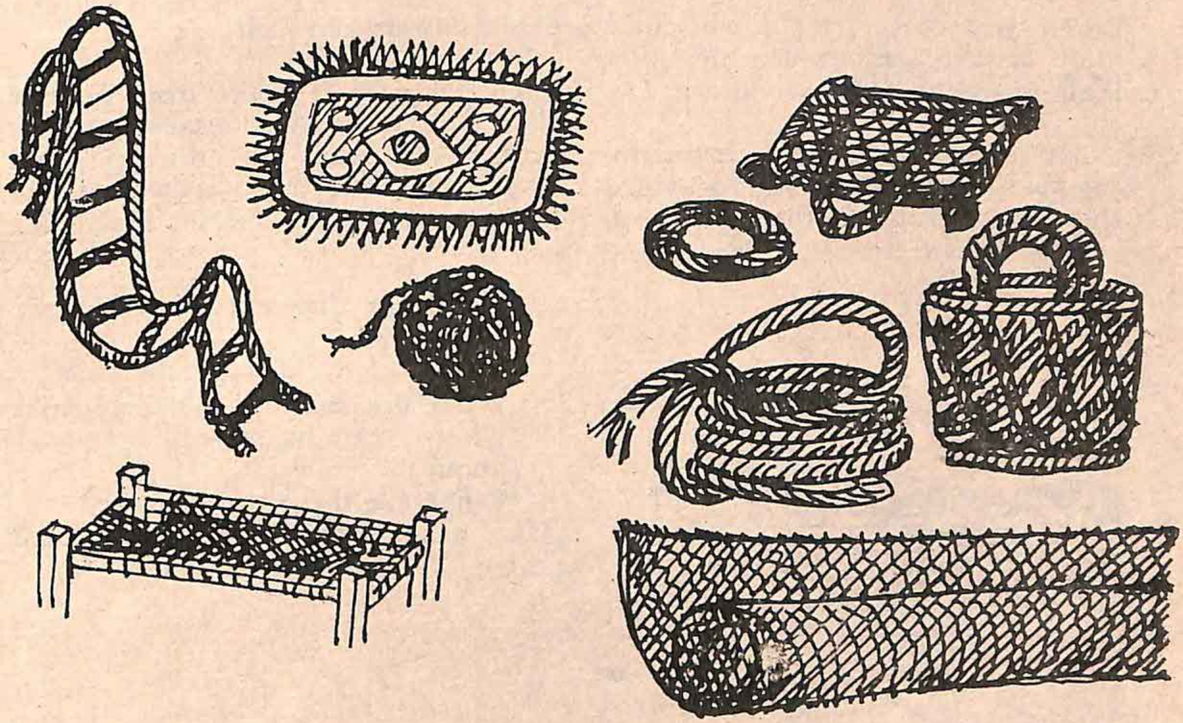
If you look closely at the barks of some trees, you will see a gummy liquid flowing out through holes in the trunk. The neem tree, gum babul and the bel are some of the trees that store a sticky gum in the trunks. This gum can be extracted from the tree by making cuts in the bark and tying containers to collect the liquid that flows out. It is used to make various kinds of adhesives to bond things.



We have just read in another chapter how we make cloth from plant fibres. We make other things from fibres as well. Gunny bags and sacks are commonly made from jute fibres. They make strong material and can be used to pack things securely. We also make carpets and other furnishing materials out of jute fibres. Coir from coconut fibre is also useful.

Many things that we know and use today are made from rubber. Rubber comes from a tree of that name. A cut is made in the bark of the tree and the white, milky sap is collected. This sap is called latex. The latex is then processed to make rubber.

Here is a picture of some things that can be made from coconut fibres. Can you think of any others?



PLANTS FOR FUEL AND TIMBER

Many kinds of wood and dry stems are used as firewood in India and in some parts of the world. These woods are used because they burn well and are easily obtained.

Wood is also used, as we know, for building and for furniture. The wood we use for building is called timber.

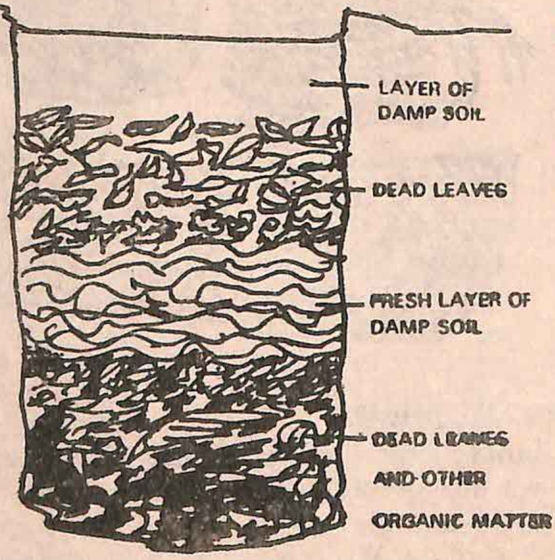
In an earlier chapter, we learnt about soil conservation. We learnt about how trees help to conserve soil by holding it firmly down by their roots. Unfortunately, because we need wood for many purposes, trees are being cut down often without care or thought about the future. This has resulted in large stretches of barren land.

Today, every country is thinking of ways of preventing this attack on trees. Trees are a part of the living world of plants. Wherever they are removed or cut down, we must think of growing other trees in their place.

PLANTS FOR MANURE

When you meet people who have gardens or who are farmers, they often talk about manures and fertilisers.

These are used to provide extra nutrients for the soil. When this is provided at the right time and in the right quantities, we have healthy plants, and better flowers and fruit.



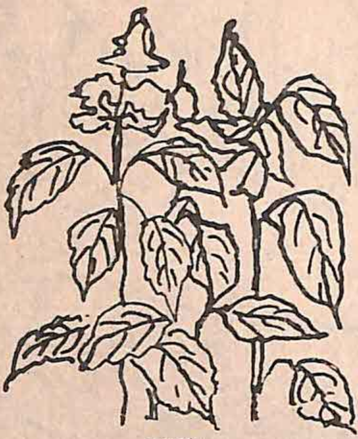
The manure is made from organic plant matter. The dead leaves and other parts of plants are put into a pit, and are covered with a fresh layer of soil. The decayed plant matter makes the soil rich

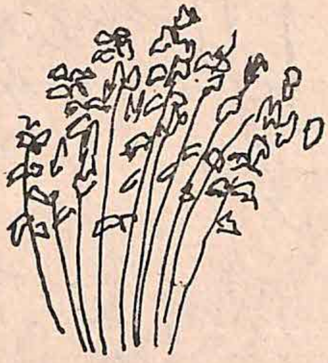
1. Name the different types of grass you know.
2. List 3 kinds of vegetable oils.
3. What are some of the medicinal plants you have seen or read about?
   What are they used to cure?

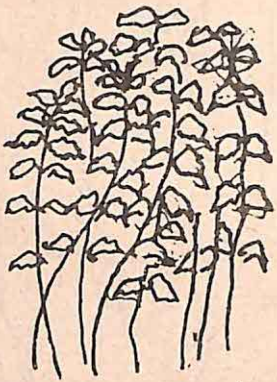
Make a manure pit in your school garden. Your teacher will help you.

WOOD FOR TIMBER AND FUEL

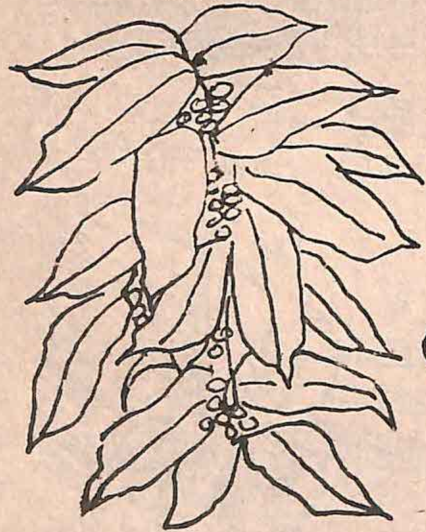
HERBS

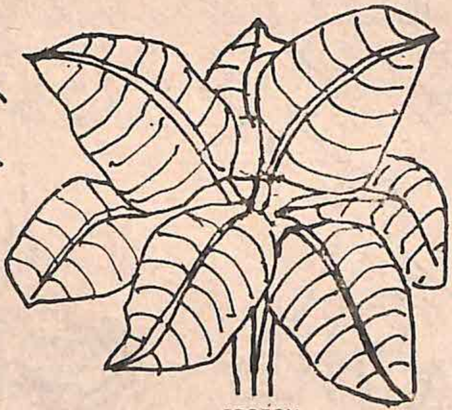

BASIL

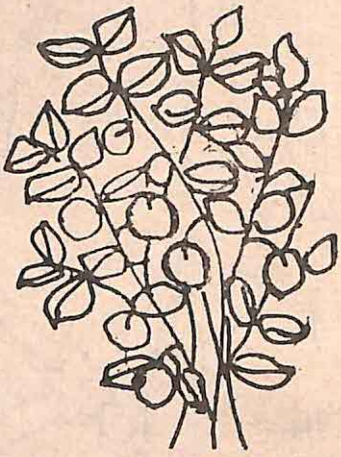

MINT


CORIANDER

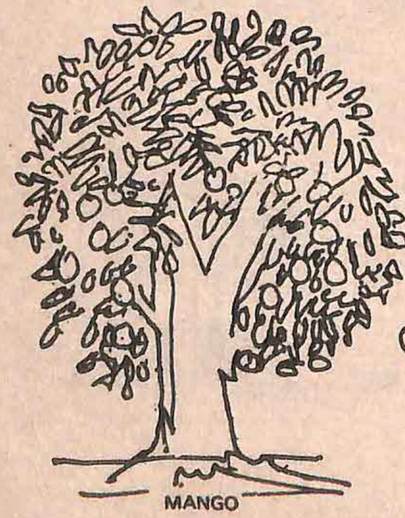
SHRUBS

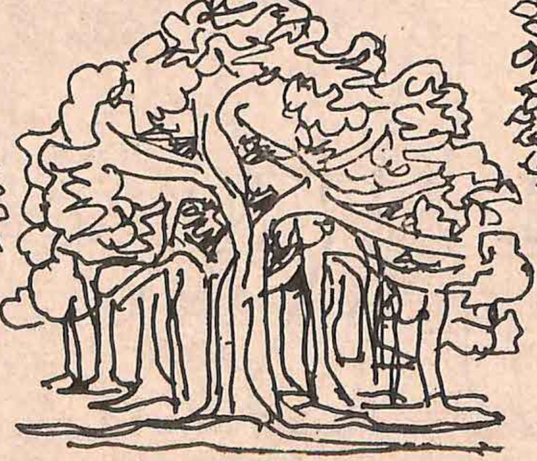

COFFEE

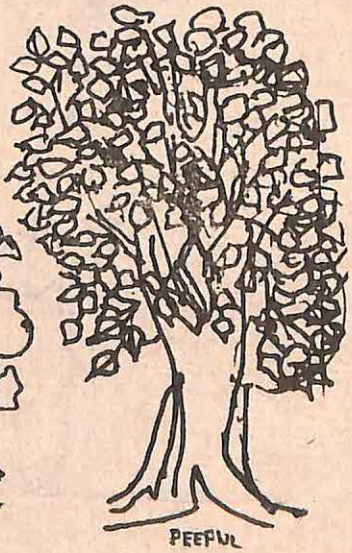

CROTON


OLEANDER

TREES


MANGO


BANYAN


PEEPUL

7 THE PLANT WORLD

In Book 3 we learnt the words flora (meaning the plant world) and fauna (meaning the animal kingdom). All living things we see around us are part of either the world's flora or its fauna.

Before we go on to look at the plant world more closely, let us see how flora are different from fauna. They are both living groups. Some of the differences we can tell straightaway. One of the first things is that they *look* quite different. Plants are usually green in colour, animals come in many different colours. Plants do not travel (some water plants can but they are very few). Most animals move all the time, some of them even as soon as they are born.

Another wellknown difference is that plants grow in many different directions. You can tell from looking at the seed of a plant what the leaves and flowers will look like, but you cannot tell exactly what shape the whole plant will take. Animals have definite shapes and sizes.

There are other differences which are not so clear. Plants and animals need different kinds of food. Plants feed on a gas called carbon-dioxide in the air. They get their nutrients from salts in the soil. Animals feed on plants and other animals. Most animals can feel things around them. They react to what they feel. In plants this is not so strong.

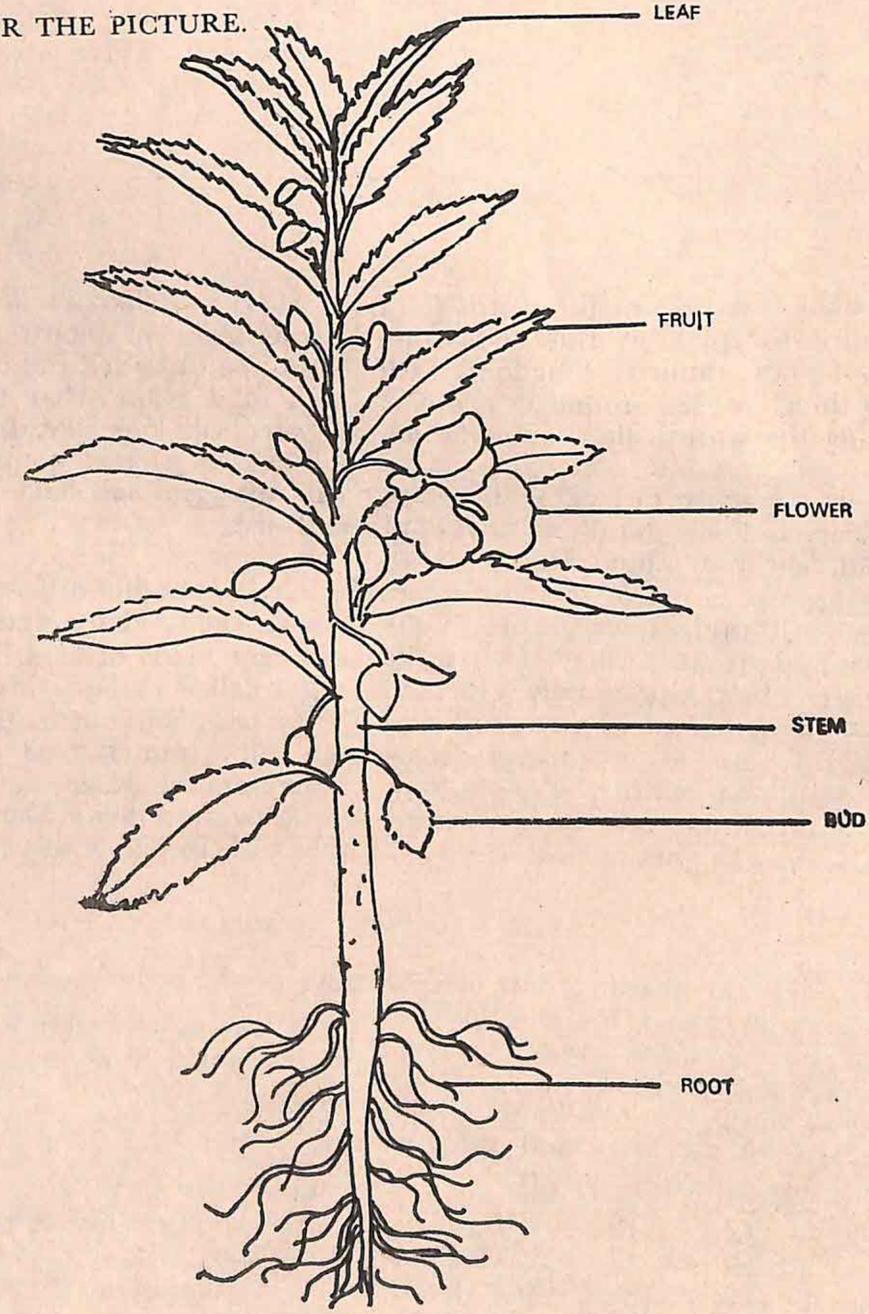
THE TWO KINDS OF PLANTS

There are so many plants in the world that scientists had to think of simple ways of studying them. One of the first things they did was to divide the plant world into two large groups. These are the *flowering* and the *non-flowering* (or flowerless) plants.

Most plants we see have flowers. Flowering plants are of three kinds. Herbs are plants with soft stems. Trees and shrubs have woody stems.

There are fewer non-flowering plants in the world than there are flowering ones. On page 64 you see pictures of both types of plants. The non-flowering plants we see quite commonly in our country are ferns and mosses. When you leave vegetables to decay, you will see a greyish layer growing over them. This is fungus, another non-flowering plant. Fir trees are also non-flowering.

COLOUR THE PICTURE.



1 What are the main differences between flora and fauna?

2 What are the different parts of a plant?

3 Make a list of other differences you may have noticed.

4 Make another list of ways in which plants and animals are alike.

5 What are the two main groups of plants?

6 Write down the names of ten trees and shrubs you know about or have seen.

Make a table. In the first column write down the name of the plant. In the second column write down whether it is a herb, shrub or a tree (write 'I'm not sure' if you are not, and find out later). In the third column write down whether it is a flowering or a non-flowering plant. Your teacher will help you make the table.

7 You can do this as a written exercise or a class quiz. You may need to look at an encyclopaedia:

Write down the names of plants and animals which give us the following:

rubber coir mutton straw paper jute pearls cotton-cloth silk honey wool

PARTS OF PLANTS

The picture on the opposite page helps you remember what you have already learnt about the parts of a plant. Nature has built the plant in such a way that each part of a plant depends on the other in some way. Let us look at some of the ways in which a plant 'works'. Each plant is a wonderful factory in itself making its own food and making it possible for other plants like itself to grow.

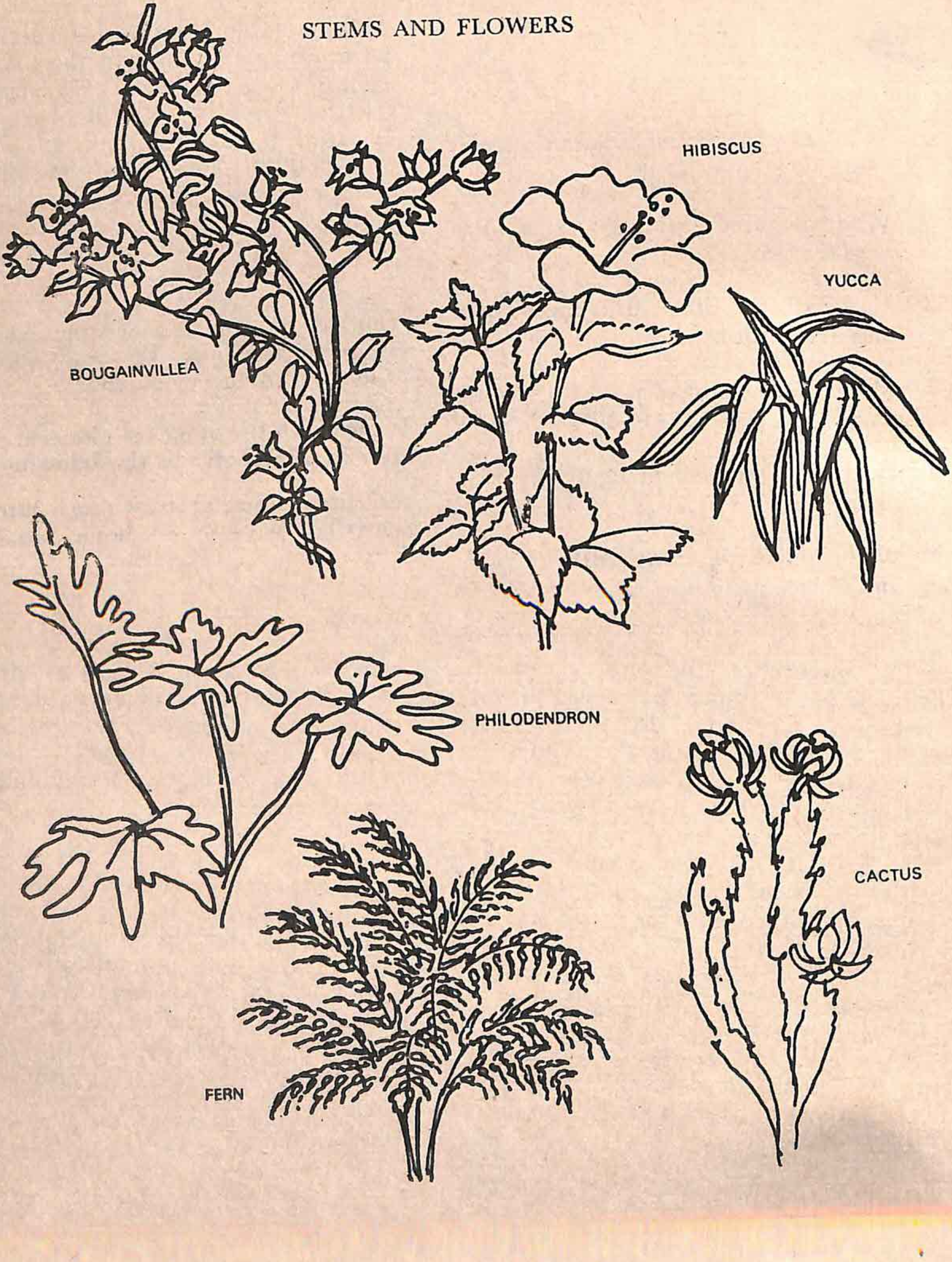
The Roots

Roots are almost always the first parts of a plant to grow. Every plant has a root or something like it to do the work of a root.

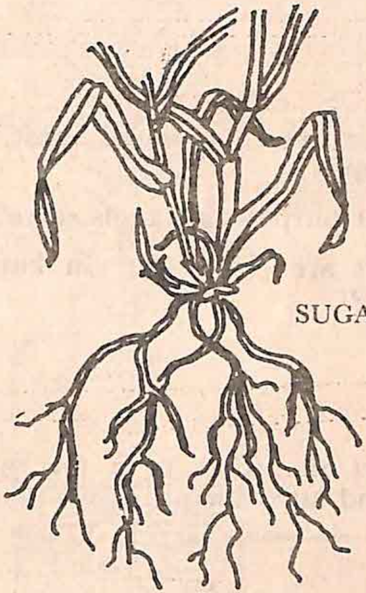
The roots hold down a plant to the soil. You cannot easily pluck a plant out of the soil, although some grasses come out fairly easily. Usually, the bigger the plant, the bigger, deeper and stronger the roots.

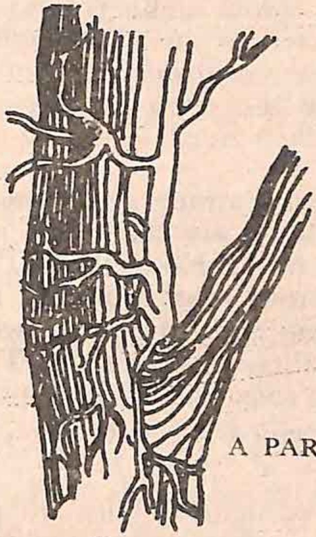
Roots have another important function or work. The plant gets its food and water from the soil through the roots. This is why most uprooted plants will wilt and die if they are left that way. That is also why, when you want to move a plant from one place to another, you have to pull it up gently by its roots and make sure the roots are not injured.

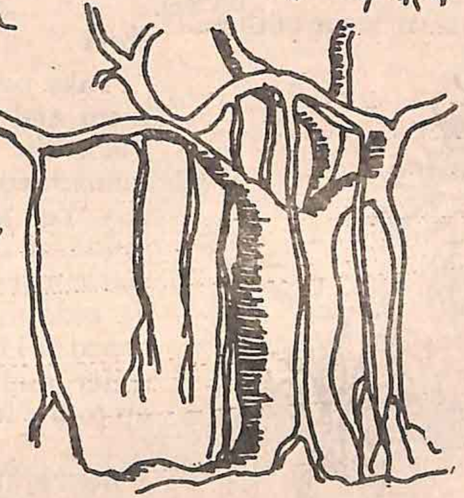
STEMS AND FLOWERS

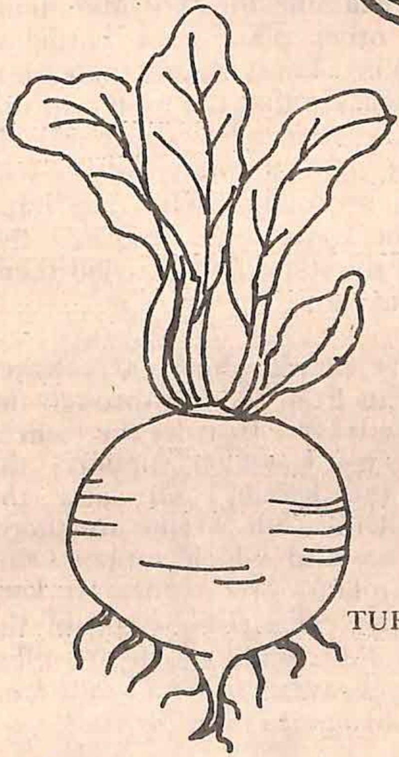


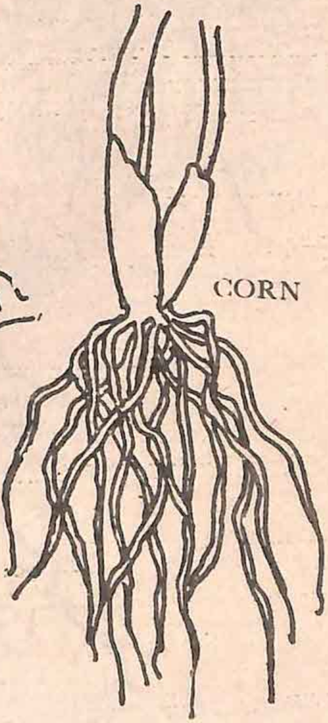
ROOTS


SUGARCANE


A PARASITE


BANYAN

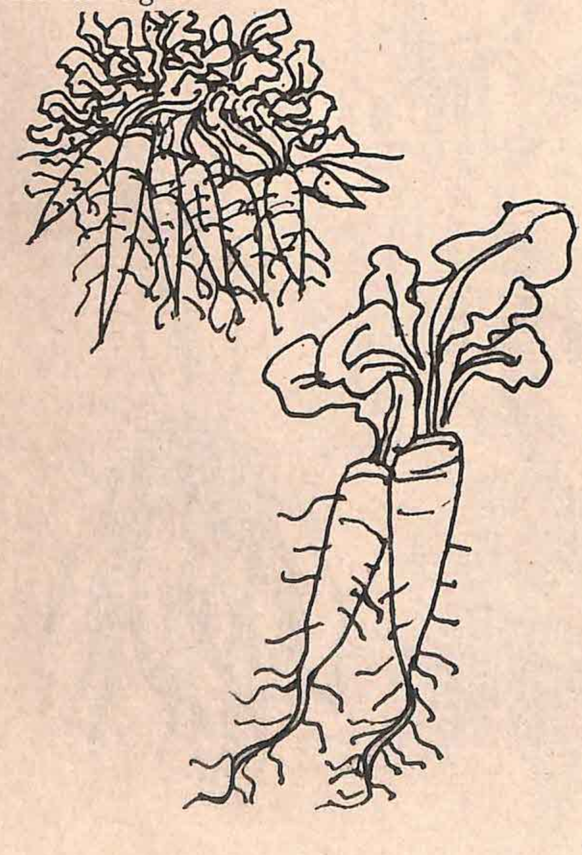

TURNIP


CORN

Most roots grow underground. In some plants such as the philodendron, the roots come out from parts of the stem and help the plant to cling to a support, usually a tree.

Some roots are strong and some are weak. Some roots are thick and juicy while others are just hairy fibres. These are called fibrous roots. Another kind of root has one main root from which branch out other, smaller roots. These are called tap roots. Roots help plants to take nutrient water into the plant body.

The roots of many plants are used for storing food. Here are some of them.



1 Where are roots found most often in plants?

2 What purposes do roots serve?

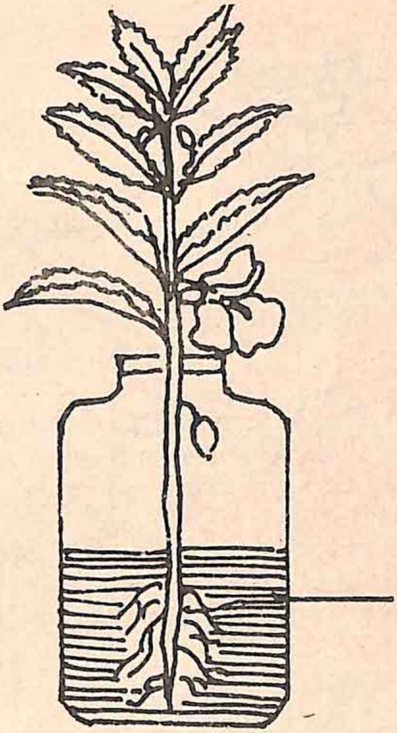
3 What are the two main kinds of roots?

Collect the roots of a few plants. Draw and label them in your books.

Stems

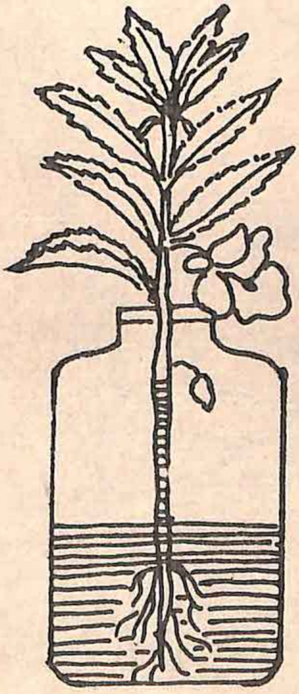
Take two balsam plants. Cut one of them and examine the root and stem. Place the other plant in a bottle of diluted red ink. Let it remain there for a day. You will see that the roots and the inside of the stem are stained red. If you cut the stem, the liquid inside will be reddish in colour. What has happened? The roots have absorbed the water, and the stems have carried them up to the leaves.

Stems are canals which carry water and nutrients from the soil through the roots to the leaves. In trees the stem is really the trunk which supports the branches, the leaves, and later the flowers and the fruit. Stems are therefore also a stand which supports the rest of the plant. Tree trunks are kept erect by the cylindrical shape of the trunk and the canals which are filled with sap. Leaves, flowers and fruit grow out of stems in most plants.



In some plants, the stems store food. They are thick and swollen. Some of these stems are found underground. Did you know that the potato is an underground stem?

Not all stems are strong and not all of them provide support to the rest of the plant. Climbers, runners and creepers are weak-stemmed plants, that is, they are too weak to grow erect and support the rest of the plant. They prop themselves up on other plants or trees or some kind of support. Some plants have tendrils or hooks. Creepers and runners grow along the ground. (see Page 68).



1 What functions do the stems of plants have?

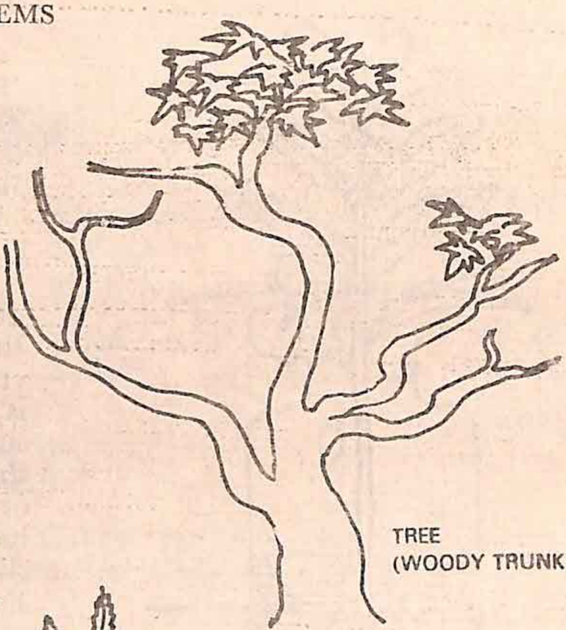
2 What is special about the stem of the potato plant?

3 How do weak-stemmed plants support the rest of the plant?

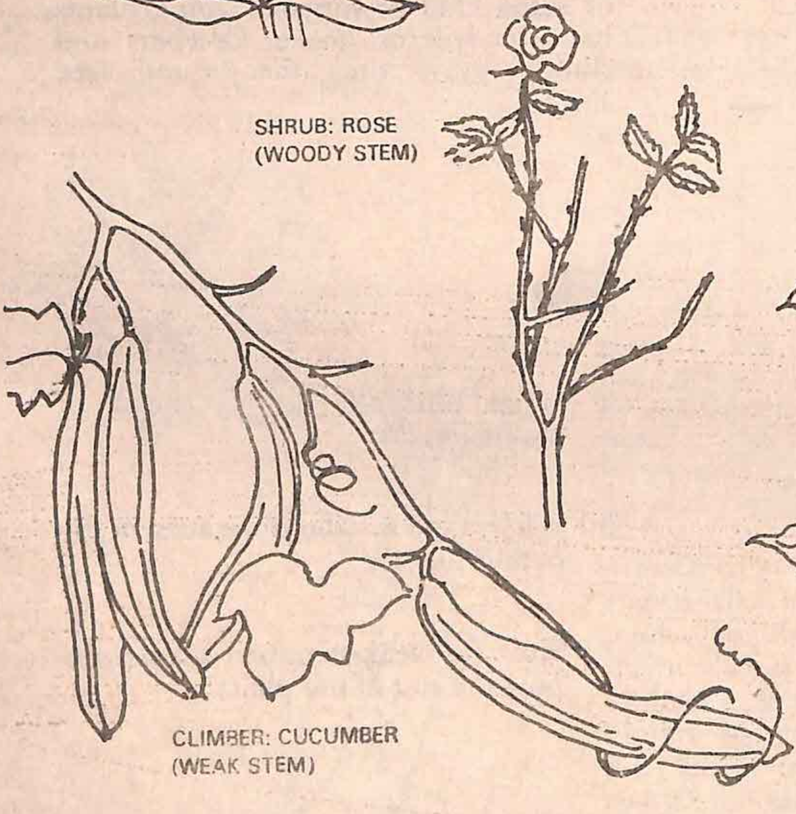
Draw the plants on page 68 in your books. Label the stems of each plant.

STEMS

HERB: MINT
(SOFT STEM)

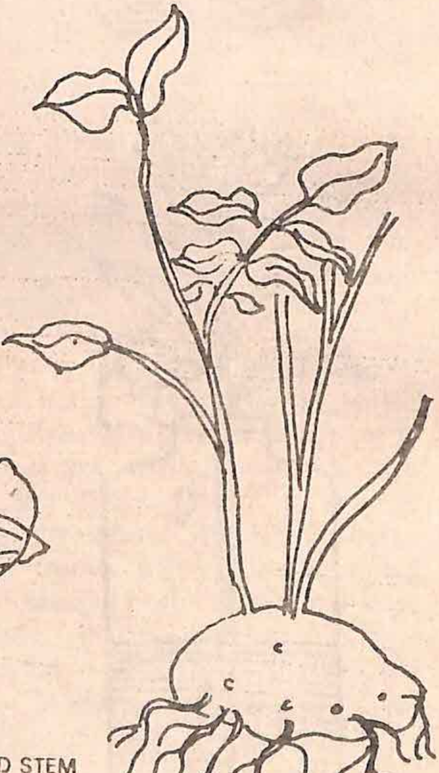


TREE
(WOODY TRUNK)



SHRUB: ROSE
(WOODY STEM)

CLIMBER: CUCUMBER
(WEAK STEM)



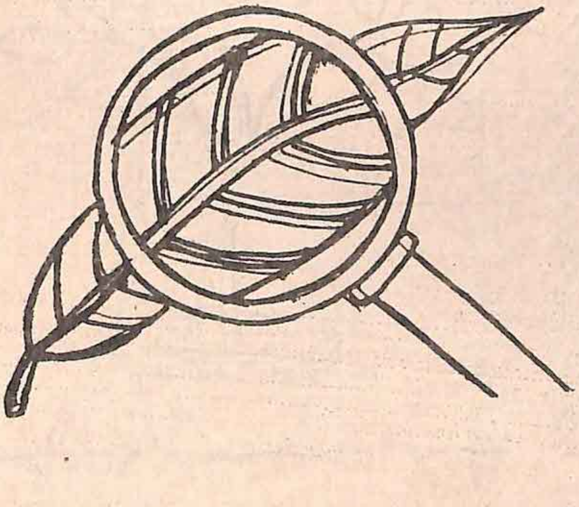
POTATO
(UNDERGROUND STEM
FOR STORING FOOD)

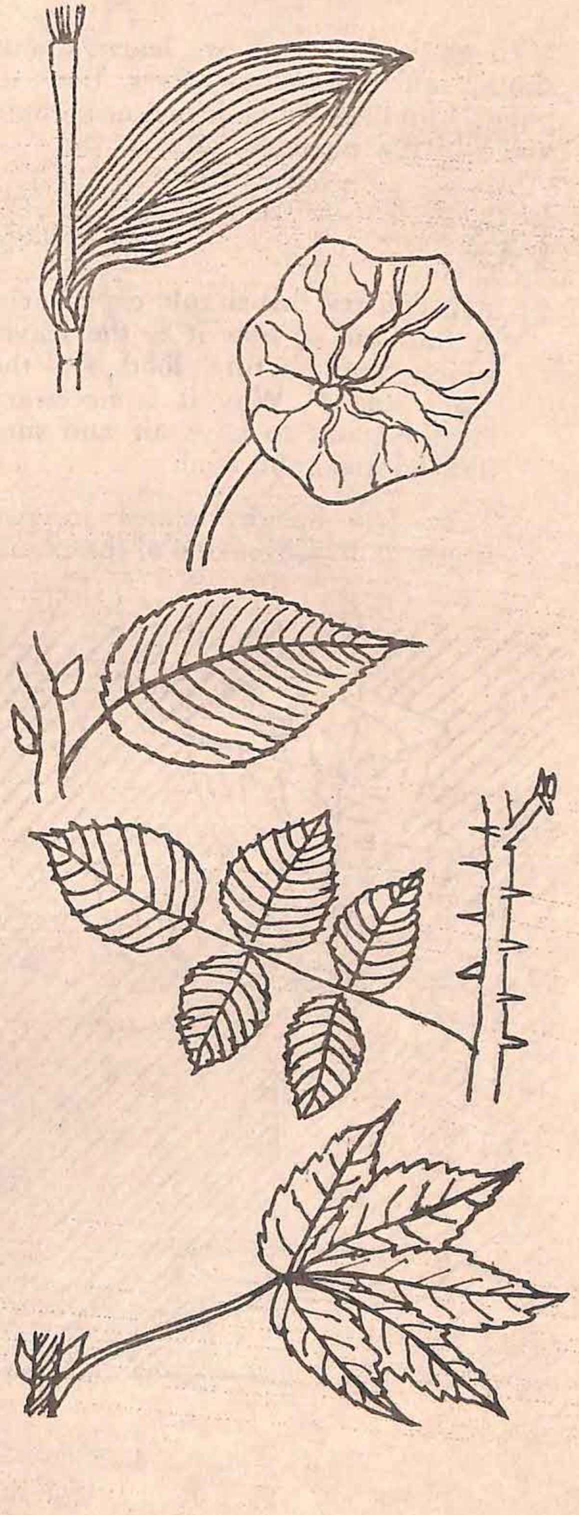
Leaves

We have just seen how it is one of the main functions of the root to take in water and salts from the soil, and how the stem is a canal through which these are sent to the leaves. It is now up to the leaves to use the sunlight to change this into food that the plant can use to help it grow and survive.

A plant also breathes through its leaves. On the surface of each leaf there are tiny openings or pores called stomata. The leaf breathes through its stomata. It takes in gases from the air and uses these gases to help it manufacture food from the salts in the water.

Here is a picture of a leaf seen through a magnifying lens. The thick line shows the main vein which leads on from the leaf stalk. The thinner lines are the branch veins. The veins are canals to distribute the water through the surface of the leaf and also to carry food to the growing parts of the plant.





In an earlier book we learnt about simple and compound leaves. Look at page 71 and say which leaves are simple and which are compound.

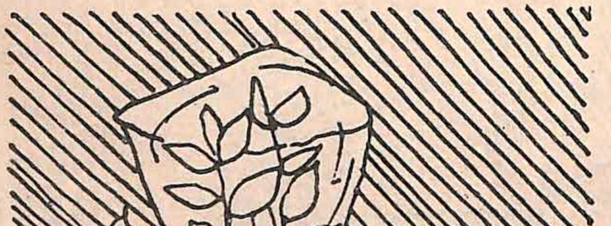
1 You can try this simple experiment to find out *a*) how it is the leaves which manufacture food for the plant and *b*) Why it is necessary for the plant to have air and sunlight to make this food.

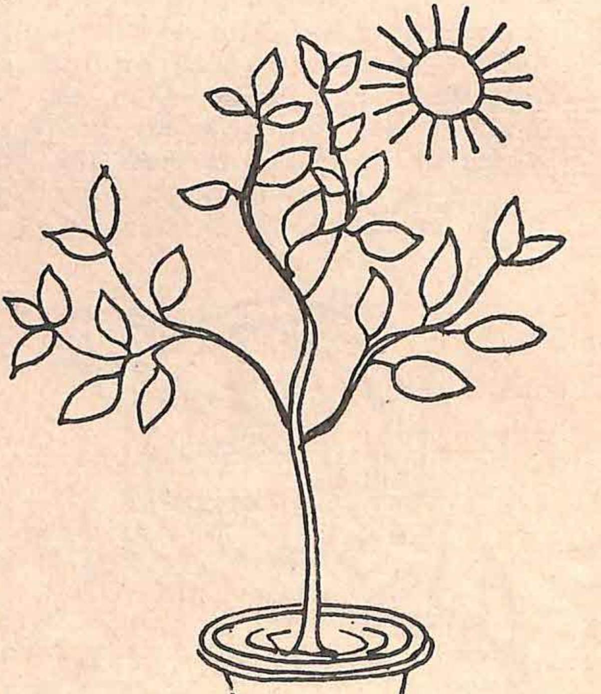
Take two healthy plants in two flower pots. Cover one of the plants with a plastic bag as shown in the picture. Take it indoors and leave it in a dark place where it cannot have sunlight. You have shut out the air with the plastic bag.

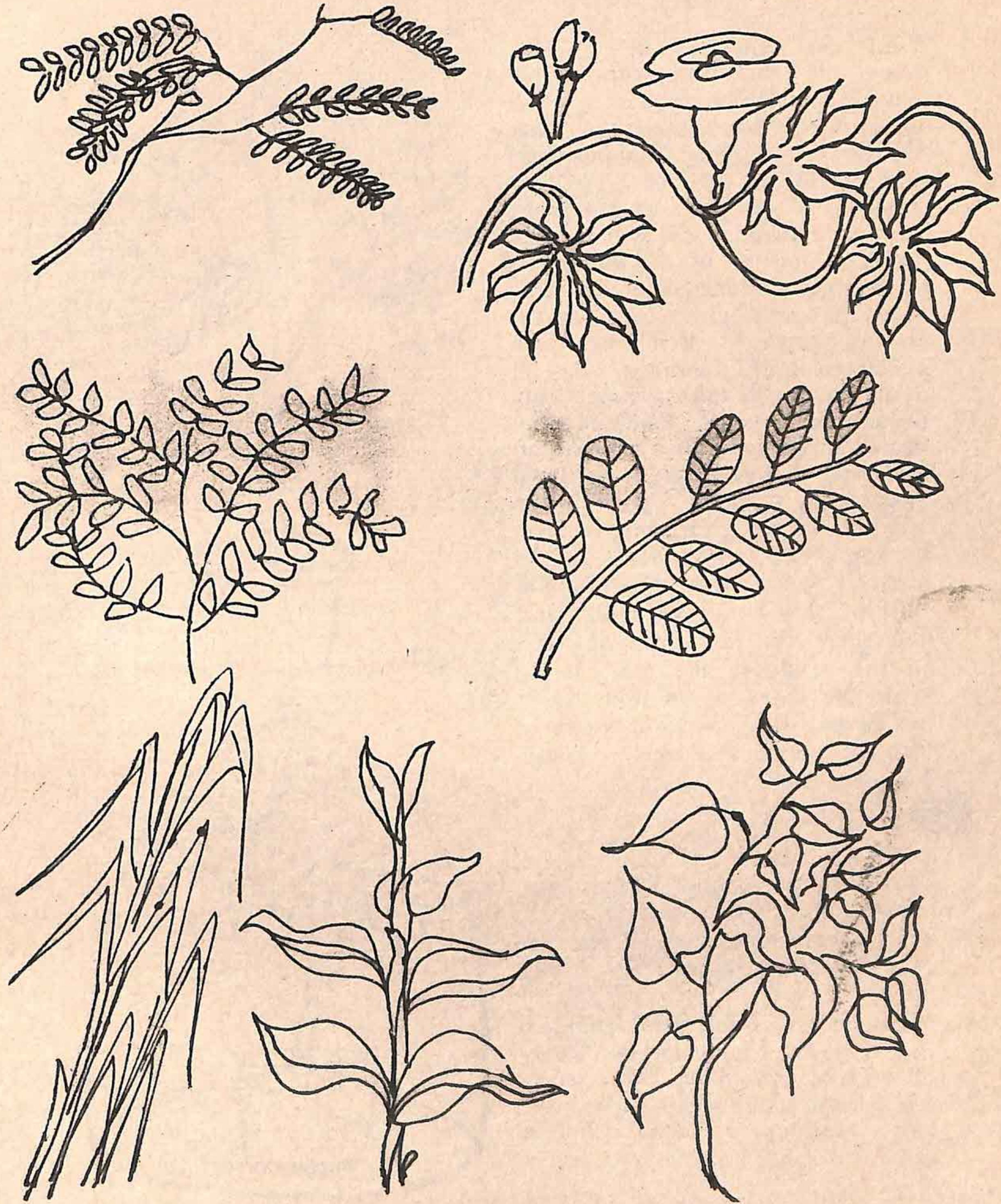
Leave the other plant in the sunlight. Leave both the plants in these places for three days. Now bring the two plants together, remove the plastic bag from the indoor plant, and compare both plants. Write down notes on the following:

a) the colour of the leaves

b) the general look of the plant.

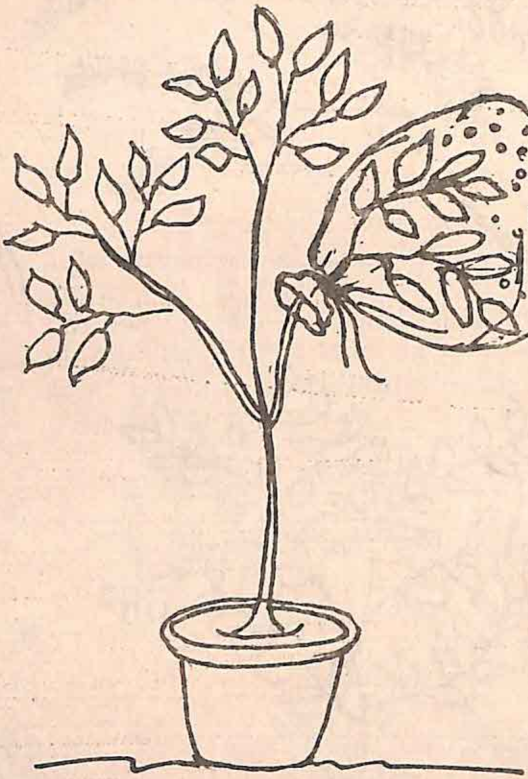


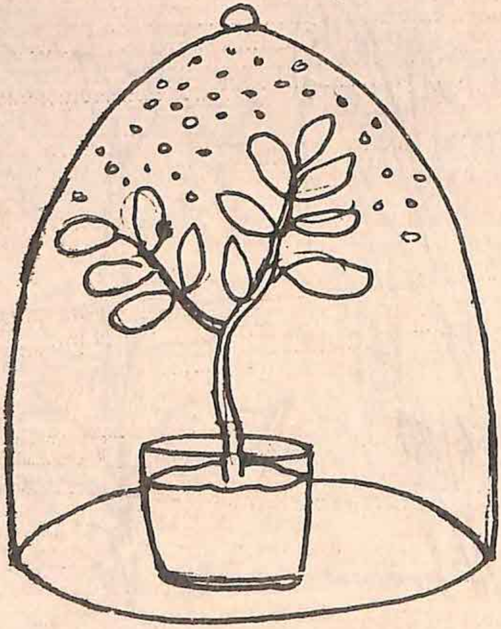




COMPARE THE LEAVES AND STEMS NAME THEM

2 You can show that plants give off moisture from their leaves in sunlight. Tie a small polyethylene bag round the leafy branch of a plant, making sure that the leaves are not injured or crushed. If you look at the plant the next morning, you will see tiny drops of moisture on the inner part of the polyethylene bag. The same thing happens when you breathe on a mirror. You can see moisture on it. Another way of doing this is to take a small leafy branch of a plant. Place it in a beaker of water. Pour a little oil on the water to prevent the water from evaporating quickly. Now place another, larger glass container on the top of the small beaker and the plant. Keep this in sunlight. Within a few hours you will find that there are tiny drops of water on the inside of the glass cover. Wipe the moisture off and cover the leaves with bees-wax or vaseline. Replace the glass cover. What happens now?

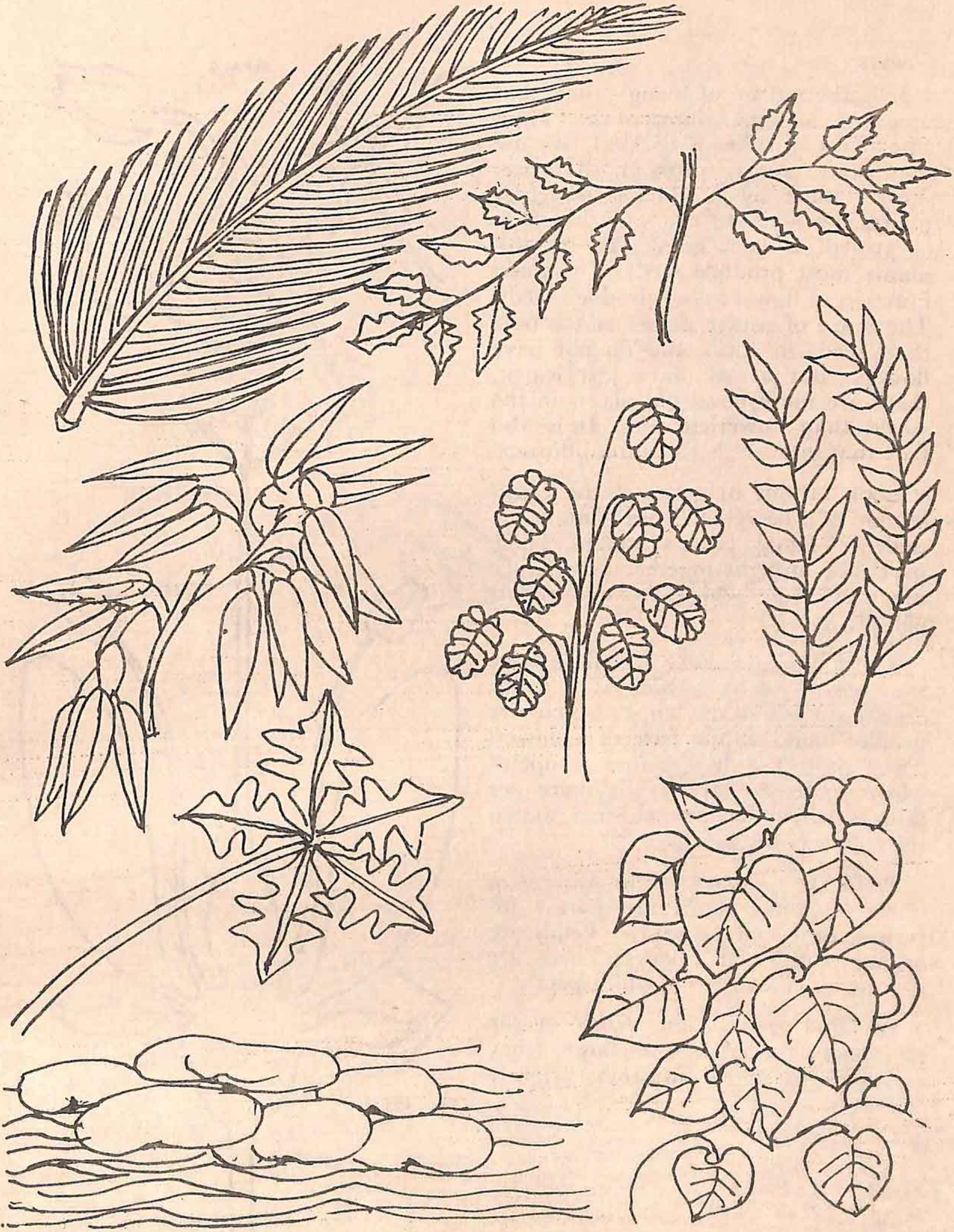




1 Why are leaves one of the most important parts of a plant?

2 Why would a plant die if you left it in complete darkness for a long time?

3 What do you think would happen if you covered some of the leaves of a plant with thick black paper and left the paper on for a few days? How would the leaves be different from the other (uncovered) leaves of the plant?



NAME THE LEAVES.

Flowers

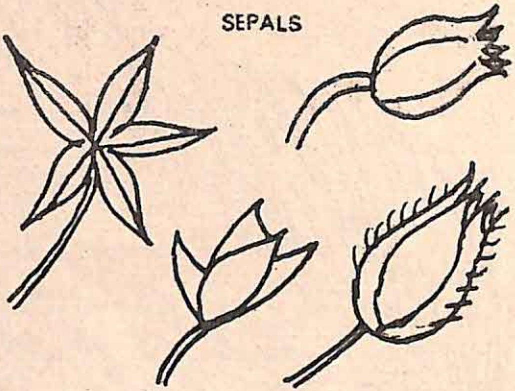
It is the nature of living things that they produce other things of their kind. The plant thus keeps its kind (we use the word *species*, pronounced 'spee-sheez') alive by producing daughter plants like itself. In this way the chain of growth is kept going. To do this plants must produce seeds. The main function of flowers is to produce seeds. There are of course plants which bear their seeds in cones and do not have flowers. But as we have just learnt, there are more flowering plants in the world than flowerless ones. It is also true that most seeds come from flowers.

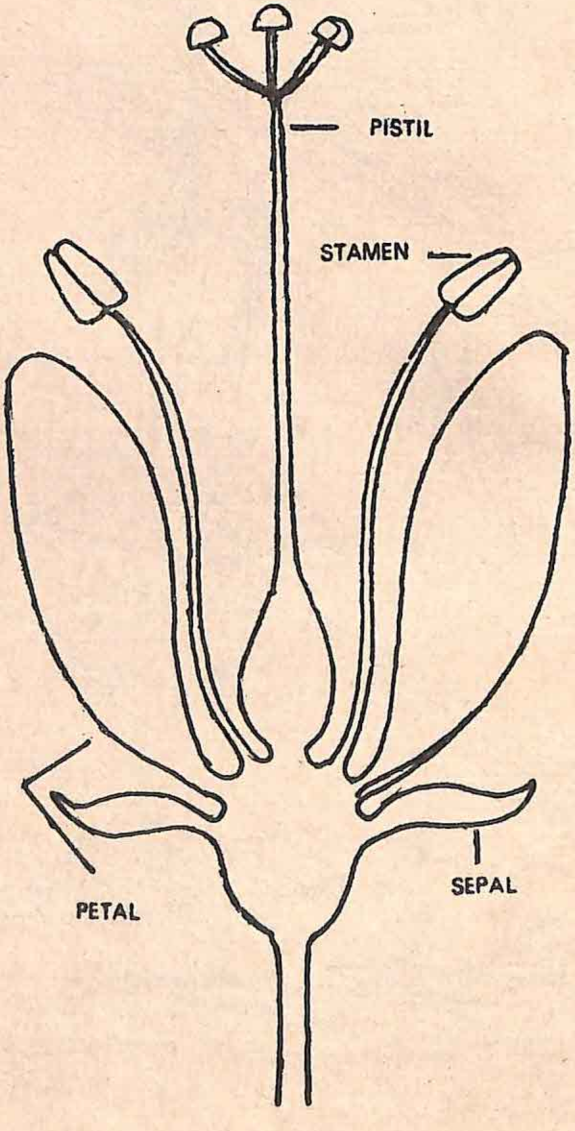
Look at this diagram of the cross-section of a flower. Flowers contain the male and female parts of a plant. These parts are brought together to produce the seeds from which the new plants will grow.

The four main parts of a flower are the *sepals*, *petals*, *stamens* and *pistils*. *Sepals* are the leafy 'cups' which are usually found at the base of a flower. They protect a bud before it opens. Most sepals are green but there are flowers which have sepals that match the colour of the petals.

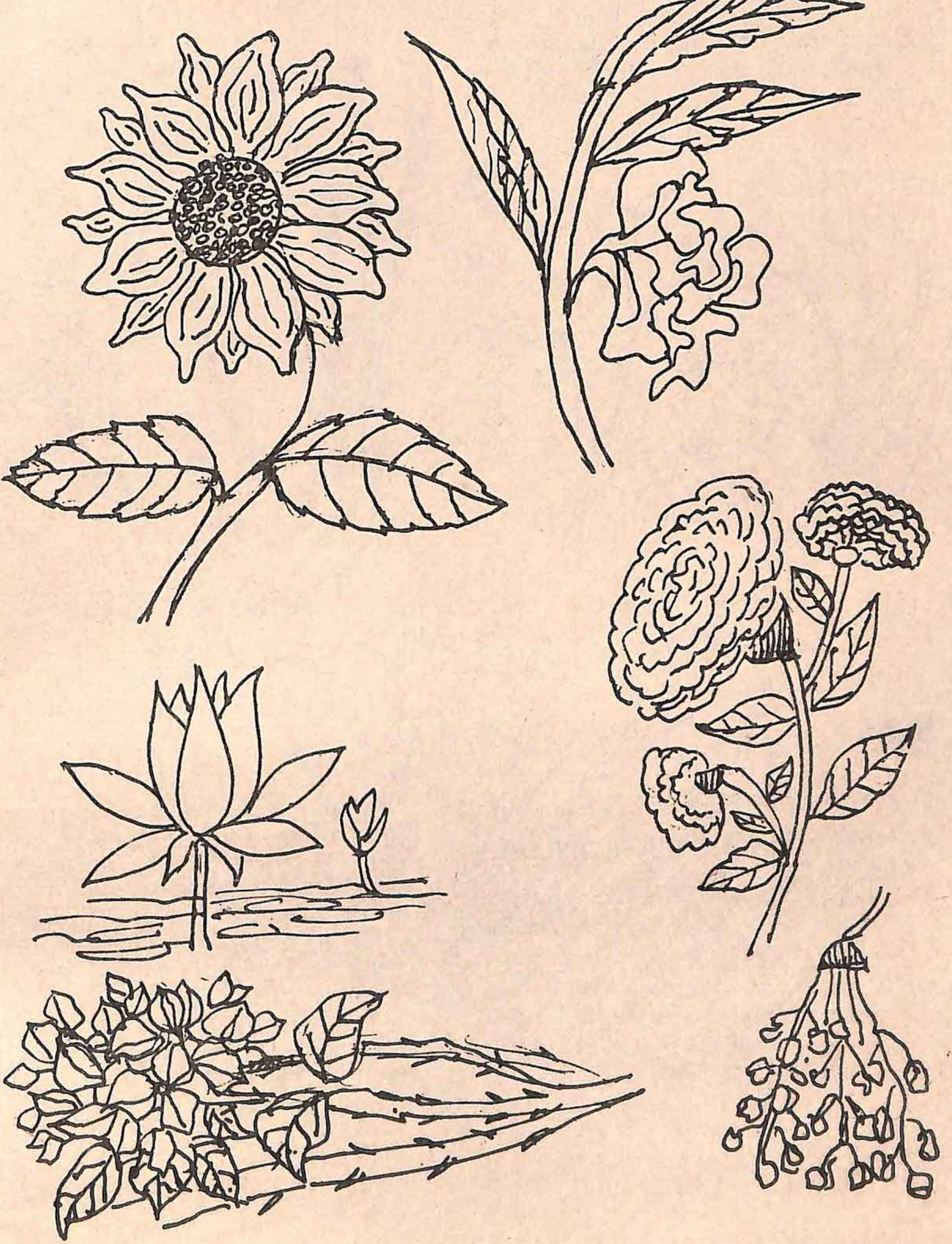
Petals are the parts we usually call a 'flower'. Some petals are joined together, others are separate. Petals are of many different colours. There are also many flowers with white petals.

We find *stamens* and *pistils* in the middle of a flower. In some flowers they are green in colour, in others brightly coloured.

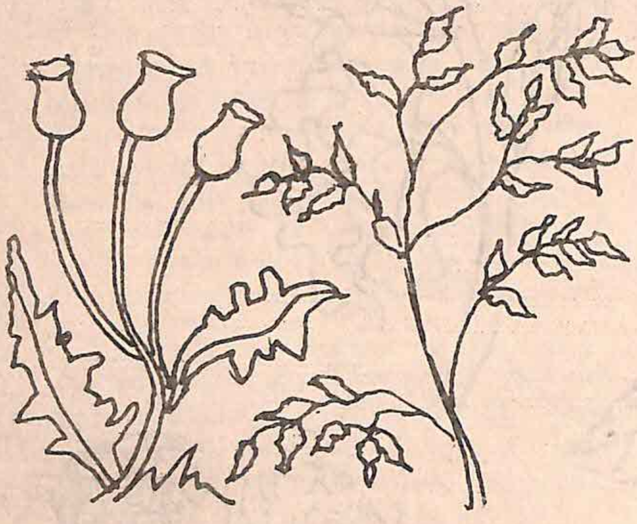




COLOUR THE FLOWERS AND NAME THEM.



Not all flowers have all these four parts. For example, grass flowers have neither petals nor sepals. The flowers are small and grow in small clusters or groups.



1 What is the main work of flowers?

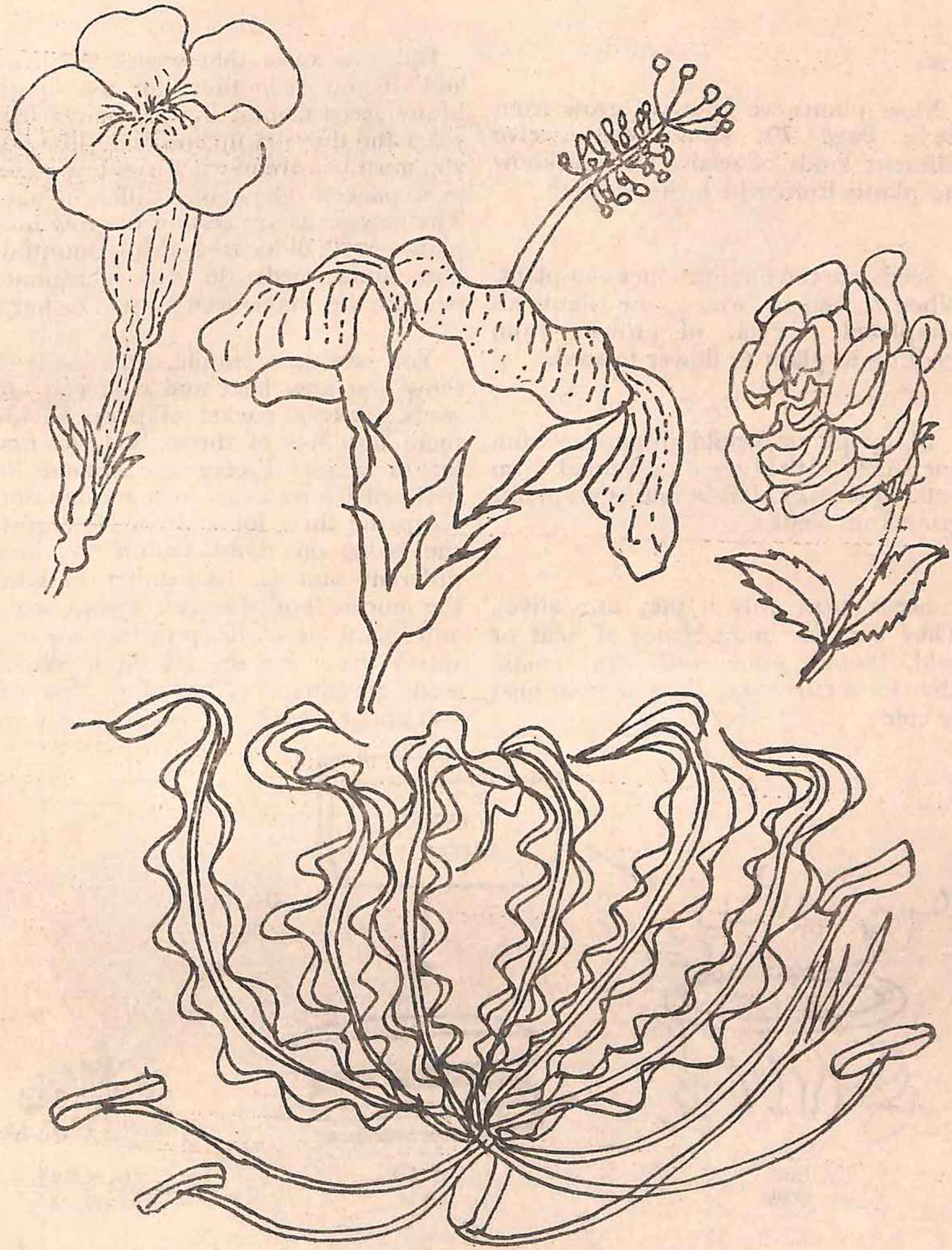
2 Draw a flower and label the parts clearly.

3 Look at page 75 and draw the flowers into your books. Label the parts in these.

4 Write down the names of two flowers which have *a*) white petals *b*) pink petals *c*) joined petals *d*) sepals *e*) no petals or sepals.

1 In your scrapbooks, paste cuttings or drawings of flowering plants you know. Write down notes to describe each plant—is it a tree, shrub or herb, how tall is it, what parts does it have? Describe the leaves, stems and flowers.

2 Draw and label the flowers on page 77. Colour them.



Seeds

Most plants we know of grow from seeds. Page 79 shows you twelve different kinds of seeds. Do you know the plants from which they come?

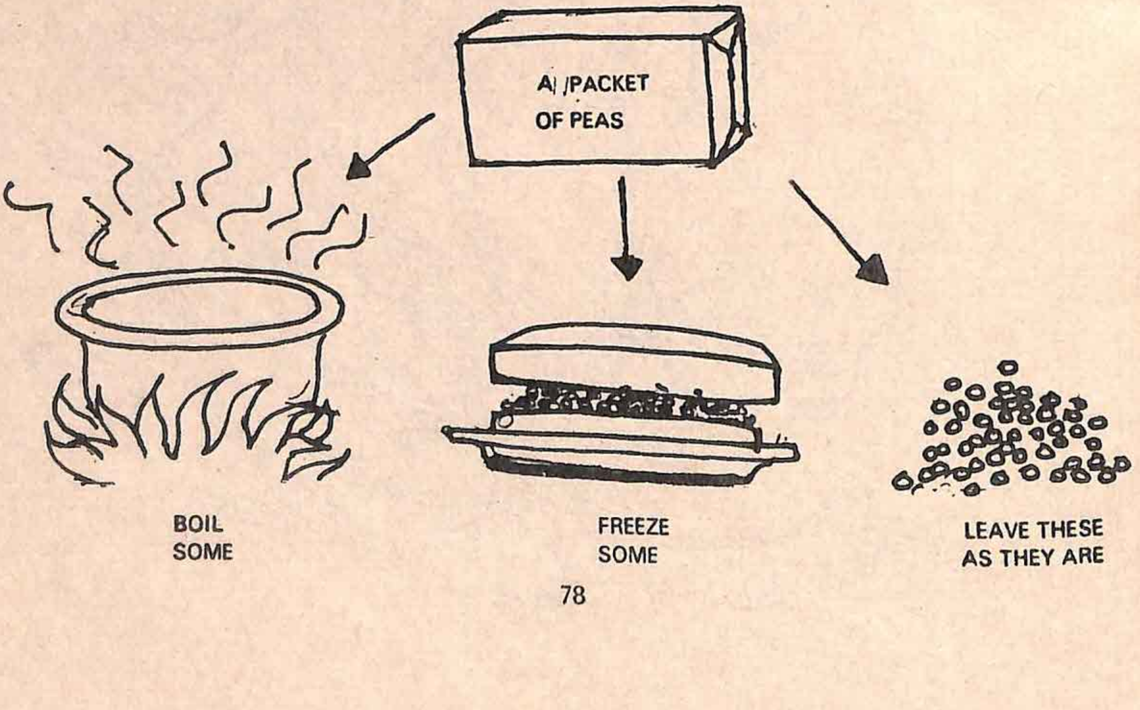
Seeds are the final product of a plant. When a seed is formed, the plant has completed a cycle of growth—from seedling to plant to flower to seed.

Many plants would disappear from our world if they were prevented from making seeds. This is because new plants grow from seeds.

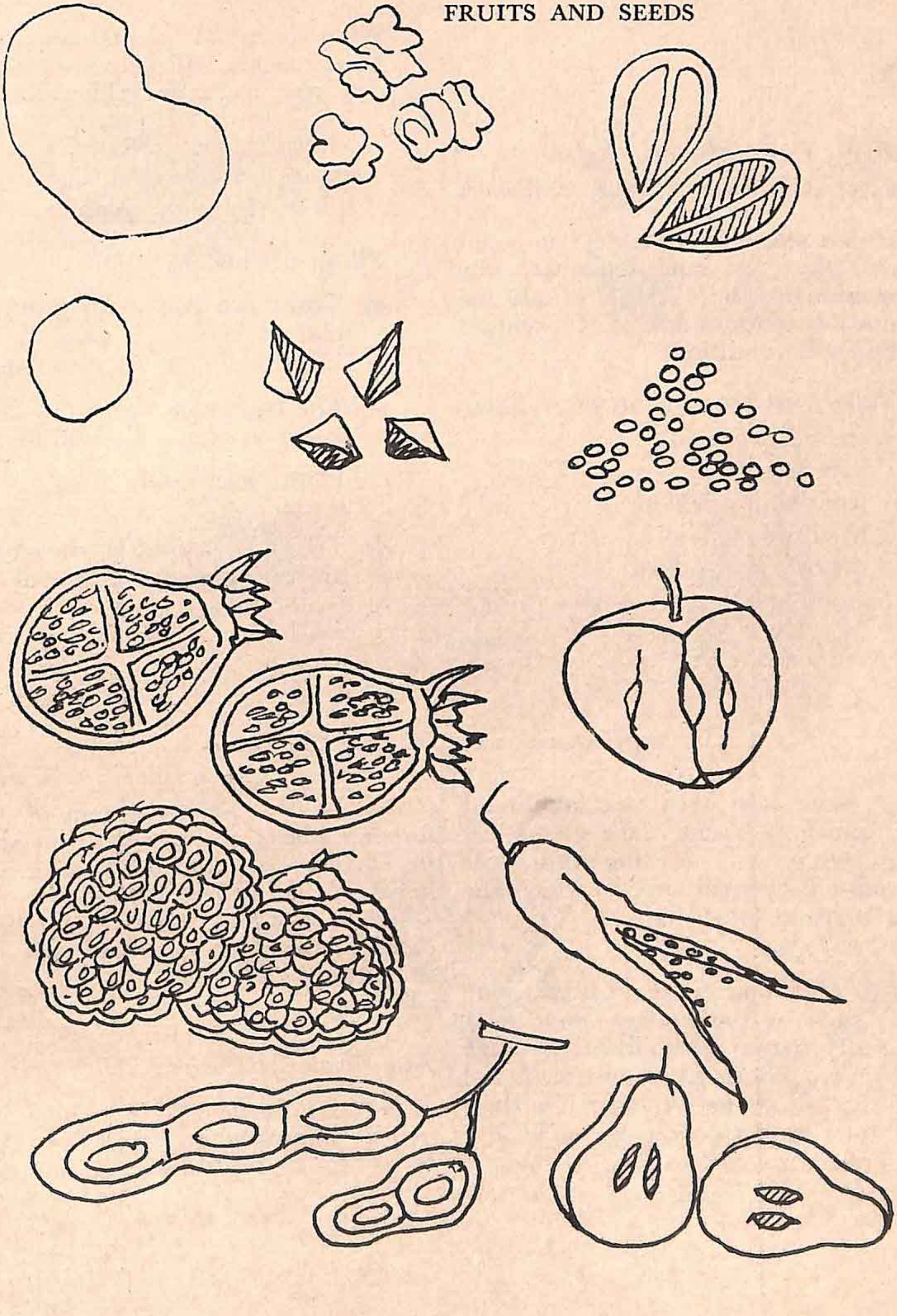
Seeds grow only if they are 'alive'. They can die in extremes of heat or cold, though some seeds can remain alive for a fairly long time in great heat or cold.

Did you know that seeds can grow 'old' if you keep them for too long? Many seeds cannot live beyond a few years and they dry up and die. This why you must be careful when you buy seeds in a packet. They may differ in age. The new seeds are certain to grow into plants. With older seeds this is doubtful. Sometimes seeds do not germinate because they have been injured or hurt.

You can do a simple experiment to show you how heat and cold can kill seeds. Take a packet of peas. Divide them into lots of three. Boil the first lot in water. Freeze the second lot between ice-packs or in a refrigerator. Keep the third lot as it is. Now grow the seeds on moist cotton in three different saucers. Remember to label the saucers 'boiled seeds', 'frozen seeds' and 'plain seeds'. Keep the saucers in a warm place for several days. Which seeds germinate? What does this tell you about seeds?



FRUITS AND SEEDS



1 Name three foods which are
a) seeds *b*) fruits *c*) leaves *d*) flowers

2 If you planted a few seeds in a pot and they did not germinate, why would this be? Think of all the possible reasons including weather and soil conditions.

3 Make a list of two plants which have:
- smooth seeds
- hairy seeds
- seeds with prickles
- hard, woody seeds
- smooth, fleshy seeds
- many seeds in the same fruit.

4 What parts of plants are these? Your teacher will help you, or you can look up an encyclopeadia.
- peppercorns
- apples
- spinach
- bananas
- cabbage
- onion

5 Fill in the blanks.

a) There are two main groups of plants:
——— and ———plants.

b) The four main parts of a flower ——, ——, ——— and ———

c) Plants grow only from ——— seeds.

d) The older a seed is, the smaller are the chances that it will——.

HOW PLANTS MAKE THEMSELVES AGAIN

We have just been reading about seeds and how plants make themselves again from seeds. This is the commonest and most important way in which the plant keeps its kind alive.

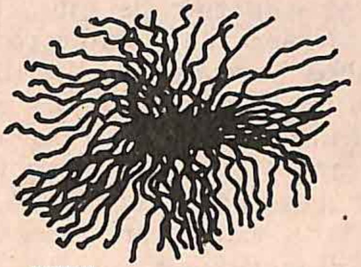
Seeds are found mostly in fruit. Some fruits, such as the mango, have only one seed, whereas others like the orange have several. Both fruits and seeds are such that they cannot move on their own, they are helped to do so by the forces of nature.

One of the most important of these forces is *gravity*, a force we learnt about in Chapter 4. The force of gravity helps the fruit or seed fall to the ground where it can take root. Heavy fruits can fall with great force and split open to scatter the seeds.

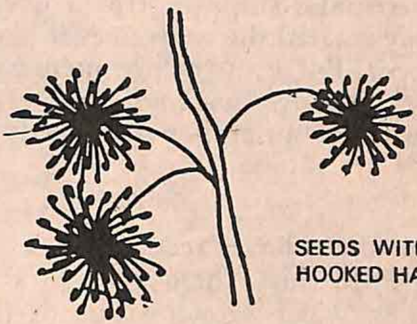
New Plants from Seeds

For hundreds of years, men have helped plants make themselves again by collecting seeds and planting them

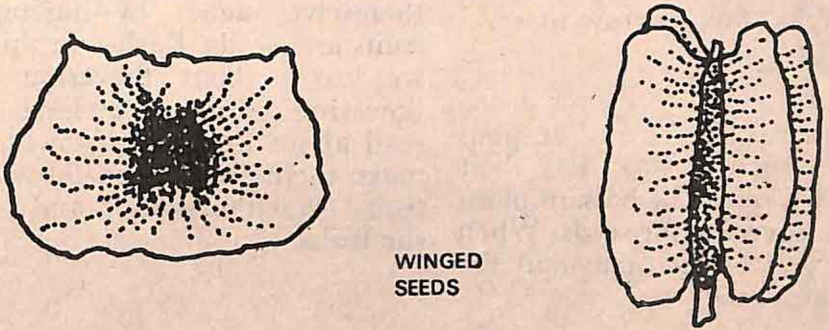
DIFFERENT KINDS OF SEEDS



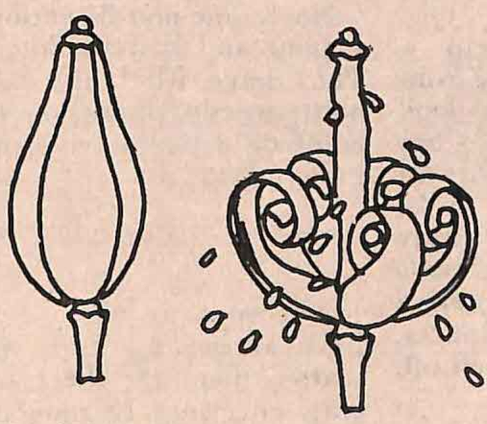
SEEDS WITH HAIRS



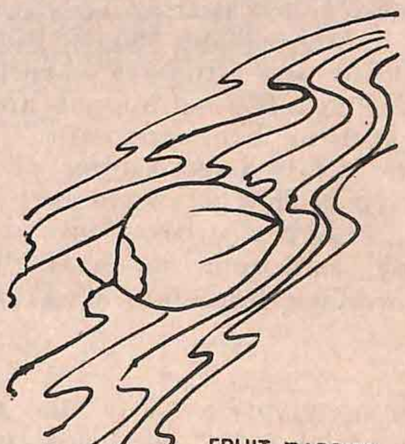
SEEDS WITH HOOKED HAIRS



WINGED SEEDS



SEEDS SHOT OUT BY EXPLOSIVE ACTION



FRUIT CARRIED BY WATER

in distant places. When people learnt how to make ships to travel overseas on, they carried the seeds to even greater distances. But even before men started to do this, plants had their own remarkable ways of spreading their seeds.

You may have seen winged seeds flying in the air. These seeds have light wings or hairs growing out of them. The seed itself is light and the wind helps carry it to other parts. When the wind drops, the seed drops to the ground and may start to grow there.

On some plants, the fruits or pods burst open in such a way that their seeds are thrown out. The balsam plant has a pod-like covering for seeds. When the pod is dry it bursts open and the seeds scatter around.

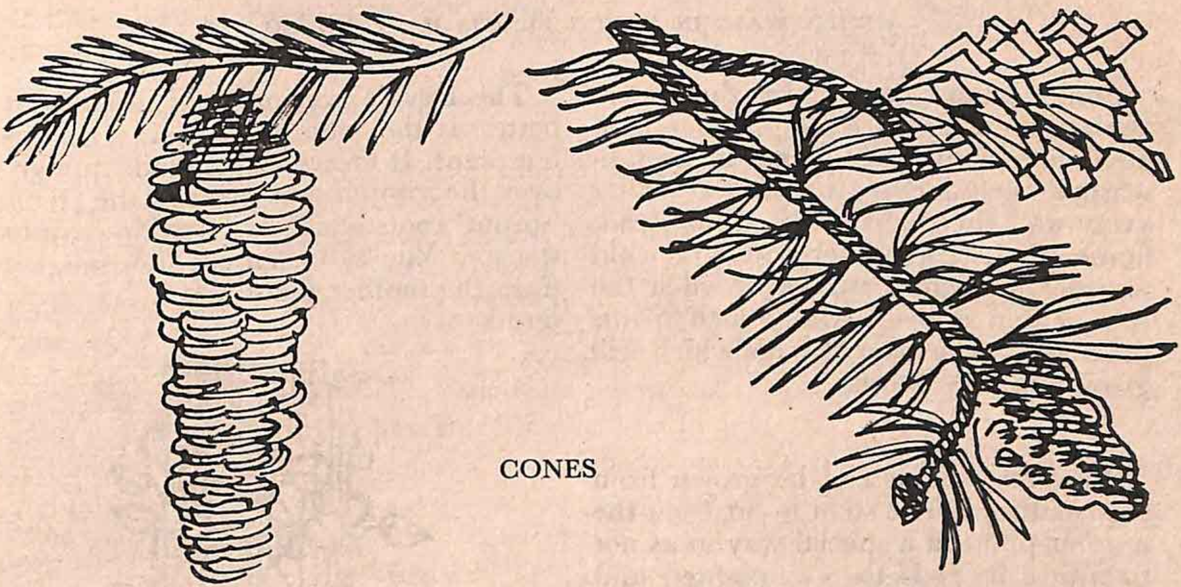
Birds, animals and even we help a great deal in scattering seeds away from the mother plant. Some fruits look colourful and attractive when they are ripe, and birds and animals are drawn to eat them. They thus scatter the seeds. Some fruits have thorny or prickly coverings. They get caught in an animal's fur a bird's feathers. They are carried away, sometimes to great distances, before they drop off or are brushed off.

Some plants grow on the edges of rivers, lakes or on sea-coasts. The coconut is such a plant. It has a remarkable way of scattering its fruit. The coconut seed has a thick fibrous covering. The fibres have air-spaces in them which help the fruit to float in water. When the fruits fall off the tree, some of them are carried by water to another part of the shore where they take root. Sometimes the water can carry the coconut to distant shores.

Most trees, shrubs and herbs make themselves again by having flowers, fruits and seeds. Earlier in this chapter, we learnt about flowering and non-flowering plants. We have also just read about how some flowering plants make themselves again through having fruits from the flowers and seeds from the fruits.

Now some non-flowering plants, such as pines and fir trees, do not have fruits. They have what are called cones, a hard, woody protection for the seeds. Some of us may have seen the fir tree in a hill-town.

The seeds in the cones of this tree have wings, and the wind helps to scatter them. As the cone opens, the scaly coverings become hard and fall off to scatter the seeds. The cypress has small ripe cones which have winged seeds.



CONES

1 How are some seeds carried by the wind?

2 What helps fruit carried by water to float?

3 How do birds and animals help to scatter seeds?

4 How do some non-flowering plants make themselves again?

1 Look at page 81 and draw seeds carried by fruit, by animals, by wind and by water. Look for other seeds in each kind and draw and label them.

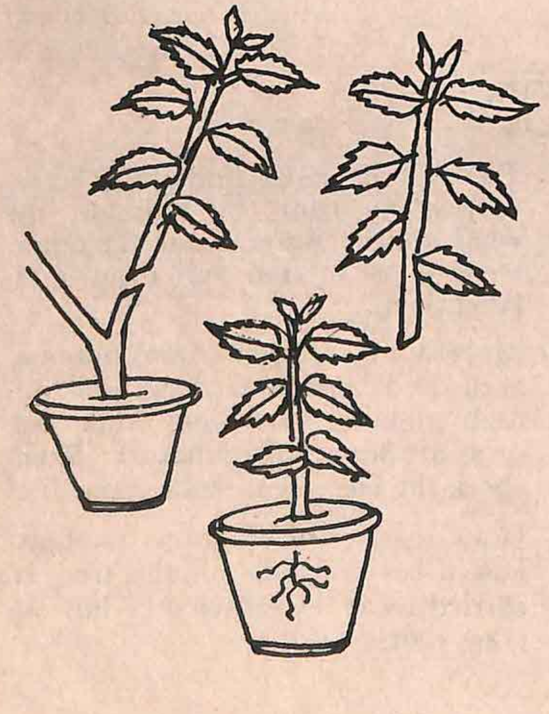
2 Make a seed collection and observe each seed. Write a short note on each and say how you think the seeds are scattered by nature. Then check the facts in an encyclopaedia.

3 Draw a series of diagrams to show how a coconut falls off the tree, is carried away by water and how it takes root.

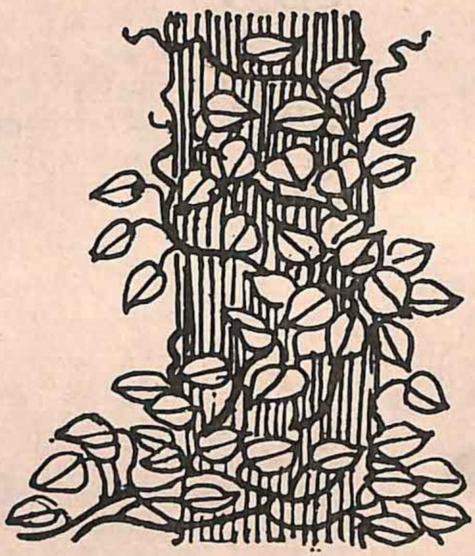
OTHER WAYS IN WHICH PLANTS HAVE YOUNG

Some plants can make themselves again without seeds. Such plants remain alive for many years, and in certain seasons their stems and leaves wither away and the plant seems to be dead. Some plants dip underground in cold weather and come up again when the cold season is over. Many such plants grow special stems and buds which will grow into new plants.

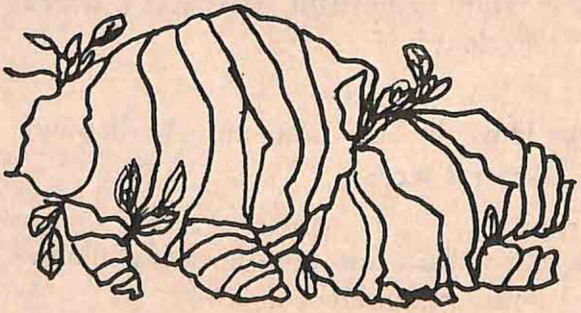
New rose plants can be grown from stem-cuttings. The stem is cut from the mother plant in a special way so as not to injure it. It is then re-planted and roots slowly sprout from the stem-cutting.



The Devil's Ivy (many of us know it better as the money-plant) is a creeping plant. It grows and spreads quickly over the ground and parts of the stems 'sprout' roots which are sent down into the soil. You can then cut the stem off from the mother plant and it can grow on its own.

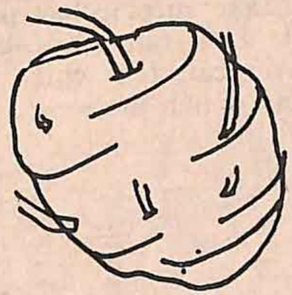


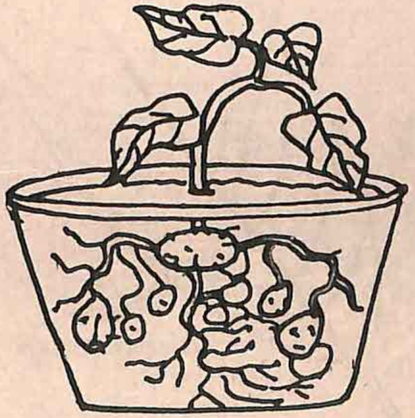
The ginger plant has a special way of making new plants. Part of the stem grows underground and is swollen. It has tiny scars on it from which roots

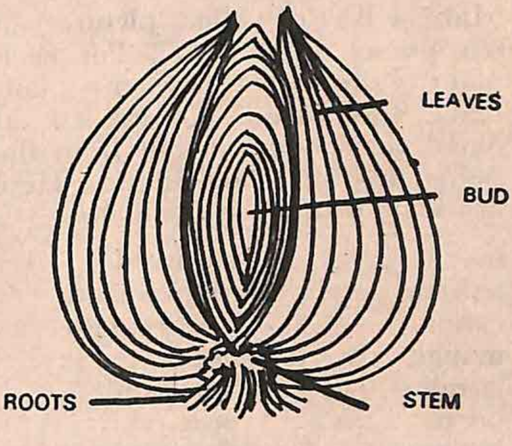


and new leaves grow. The roots push down into the ground but the leaves push up above the soil. You can now separate the new plant from the mother plant.

Potatoes are another kind of underground stem. We call them tubers. You can grow a potato plant from a potato that has sprouted tiny buds. Plant it in a large, wide pot. Watch the plant push through the soil. When it is about 30 centimetres tall, ease the plant very gently from the pot. Examine the roots and the stems which have gone underground.







If you cut an onion in half from the top to the bottom, you may see the parts shown in the drawing. You can see the fleshy leaves, the flower bud right inside. Sometimes you may see a tiny onion forming inside.

1 Are seeds the only means by which plants can make themselves again?

2 Describe and draw a cone. How are the seeds scattered?

3 How do the following grow new plants:

Devil's Ivy

Onion

Turmeric

4 Keep Devil's Ivy in a glass of water, and let it grow.

4 Make a list (or collect pictures) of ten plants around you. For each plant write down how the plant makes itself again. You can ask an older person or find out from the books in your school library. Here are some plants you might see:

rose
balsam
canna
mango
jasmine
beans
hibiscus
tomato
marigold
snap-dragon
sweet-potato
neem
pumpkin
peas
zinnia
brinjal

5 Write down the names of 20 plants which grow from seeds.

1 Cut an onion as shown in the drawing on page 85. Draw it and label the parts.

2 Look for leaf buds in the following: carrot sweet-potato beetroot radish

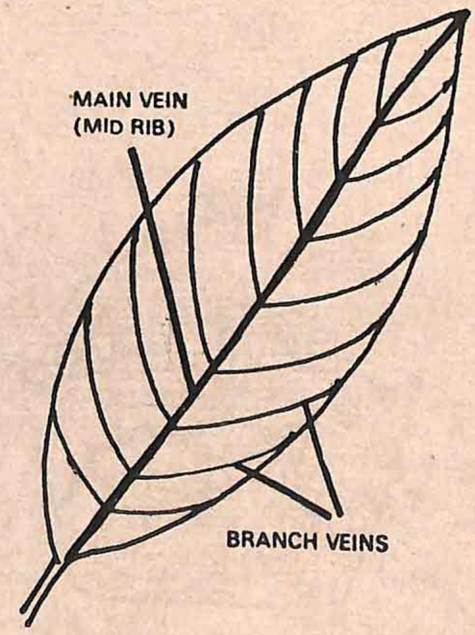
3 Grow a potato plant in your classroom. Make sure it has plenty of sunlight. Pick out one plant and see if you can tell which are the stems and which the roots.

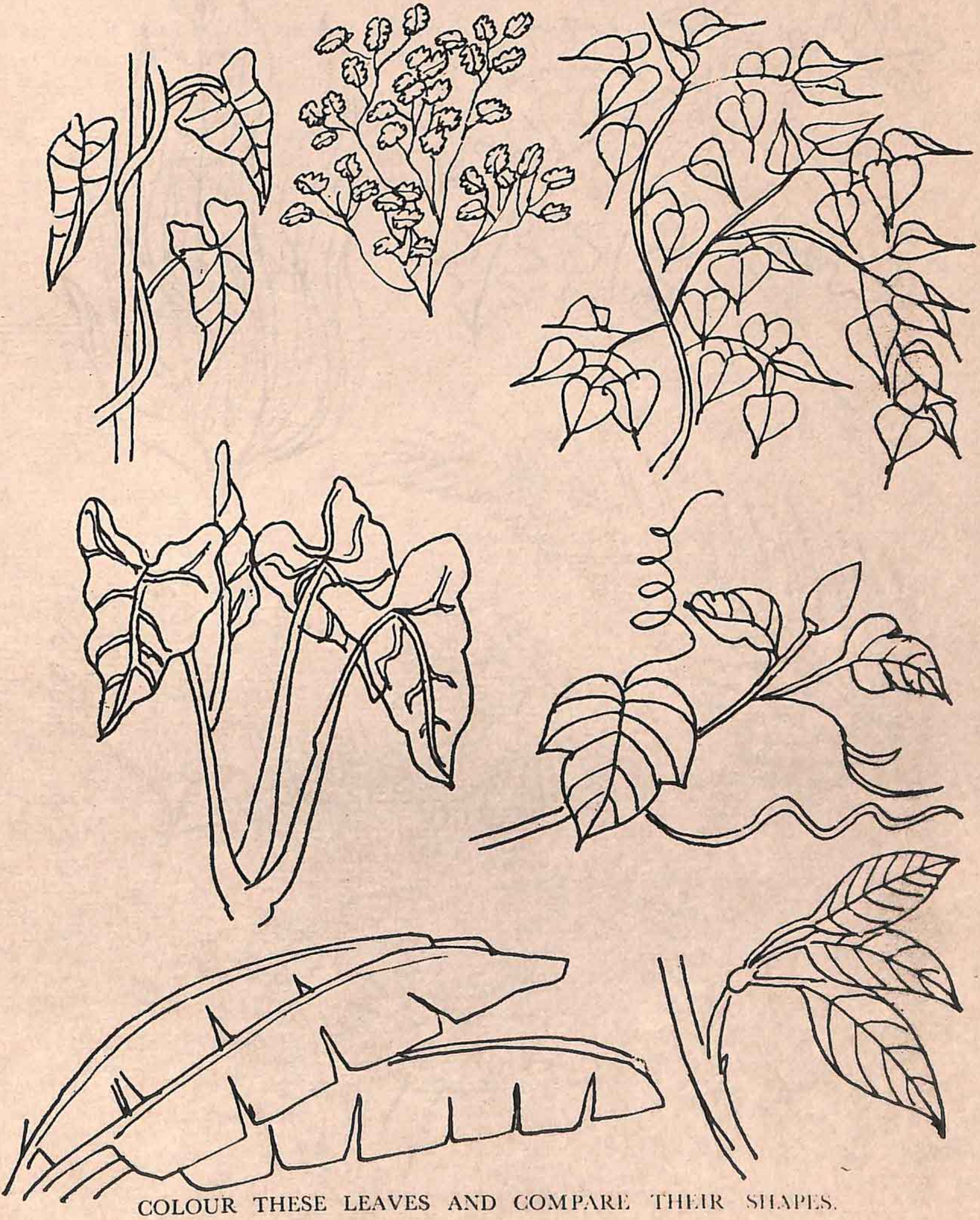
THE SHAPES OF LEAVES

Leaves come in many shapes, sizes and have different smooth-rough qualities. The picture on the following two pages gives you some idea of the great variety of leaf sizes and shapes.

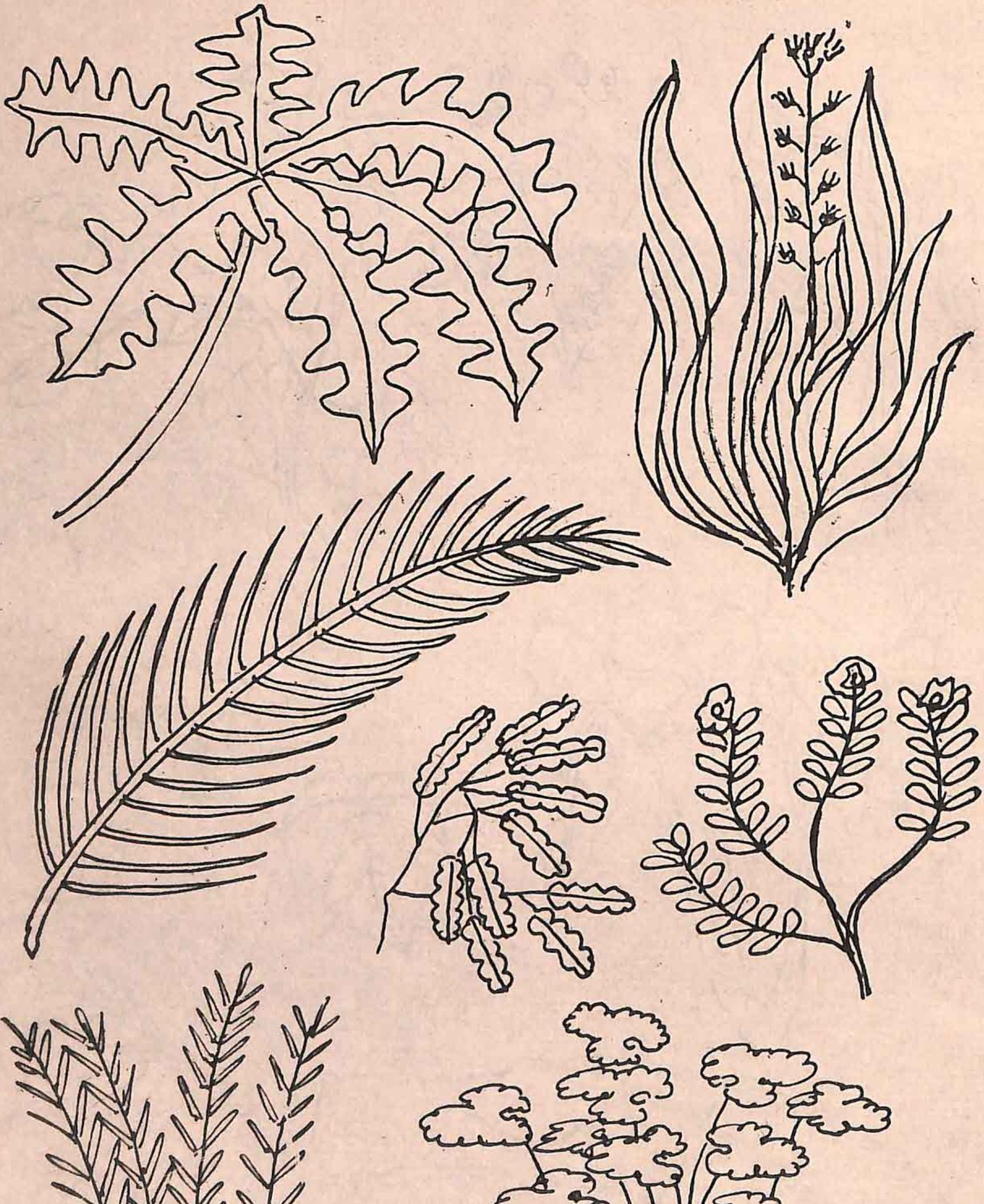
Before we think of leaves in terms of shape and feel, let us look at the parts of a leaf. Here is a drawing of one. Notice the main vein and the branching veins. Look also at the ways in which each leaf in the following pages is attached to the main stem.

There are mainly four different ways in which leaves grow from stems. The four drawings show you how.





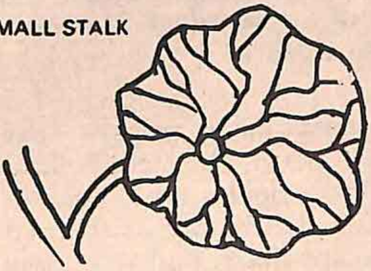
COLOUR THESE LEAVES AND COMPARE THEIR SHAPES.

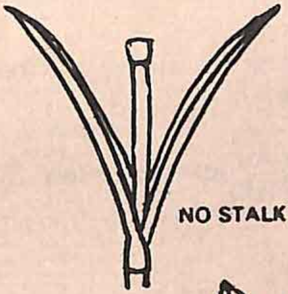


COLOUR THE LEAVES AND COMPARE THEIR SHAPES

In the first picture the leaf is attached to the main stem by a small stalk. On the second one there is no stalk at all. In the third picture, a long stalk grows out of the main stem and there are leaves on either side. In the last picture the leaf grows at the end of a long stalk.

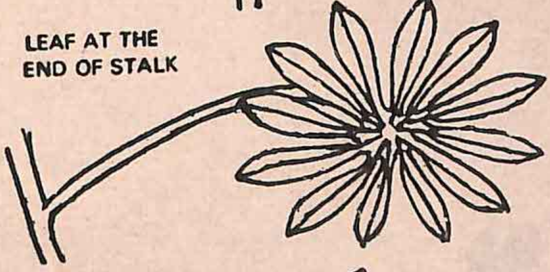
SMALL STALK

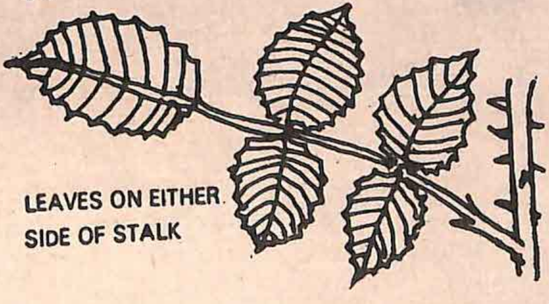




NO STALK

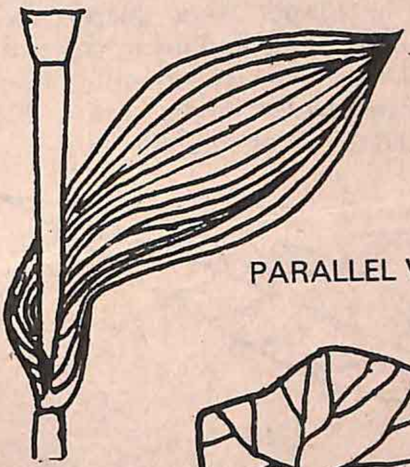
LEAF AT THE END OF STALK



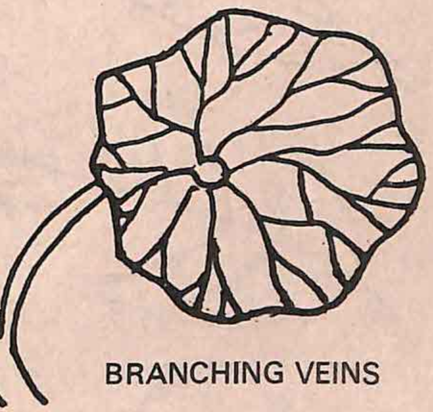


LEAVES ON EITHER SIDE OF STALK

We can see the veins in most leaves. In the leaf, the veins run side by side. We call these parallel veins. In other leaves, the veins branch all over the leaf. We call these branching veins.



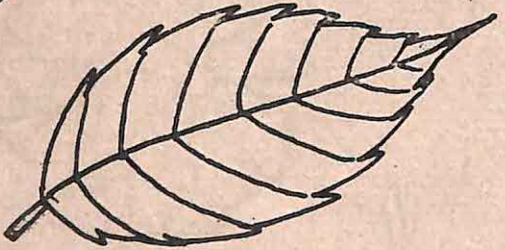
PARALLEL VEINS

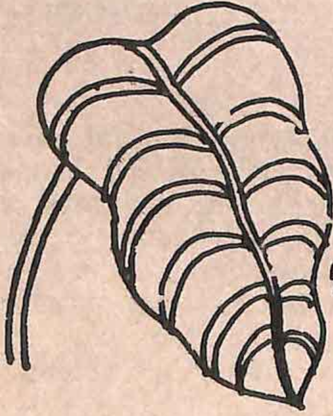


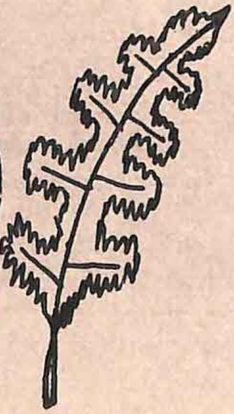
BRANCHING VEINS

There are mainly two kinds of leaves —*simple* leaves and *compound* leaves. In some plants, only one leaf grows on each leaf-stalk. In other plants, we find two or more leaves growing on the leaf-stalk. We call this group of leaves a compound leaf. Turn to pages 86 and 87 for common examples of simple and compound leaves.

Leaves and leaflets or tiny leaves have mainly three different kinds of edges. In some leaves such as in the mango the leaves are smooth on the edges. Some leaf-edges are like the teeth of a saw and we call them toothed edges. Rose leaves have toothed edges. The third kind of leaf-edge is the wavy edge where the shape takes deep curves. Some lobed-edges, such as in the clover and philodendron are smooth. Others, such as the leaves of the grape have toothed edges along the curves.







The texture of leaves

Leaves have different kinds of 'feel' or 'texture'. Some leaves, such as mango leaves have a smooth, waxy top-surface. The other side is rough and lighter green in colour.

Some leaves feel rough. Touch along the surface of a guava leaf. Do you feel the roughish texture?

Some plants have prickly leaves. In the cactus plant, the stem is fat and juicy. The leaf-prickles grow out of the stem. In other leaves such as the nettle, the prickles are sharp and poisonous.

The leaves of the casuarina are dry and scaly.

Seaweed has a smooth, slimy surface.

1 What are simple and compound leaves?

2 What are the four main ways in which a leaf is attached to its main stem?

3 Describe the leaf-edges described in this chapter. Can you think of any other kinds of edges?

4 If you think of leaves in terms of shapes, how many shapes can you think of? Are there similarities in shapes?

5 Make your own notes on the tips of leaves. Here are some words you might use:

sharp pointed curved smooth rounded

6 Draw three different kinds ofleaves.

7 Match the two columns:

grass-like plant	casuarina
oil seed	tulsi
medicinal plant	groundnut
wood for fuel	sugarcane
sweet smelling flower	mango
fleshy fruit	jasmine

1 Collect ten different leaves. Draw them in your scrapbooks. Write notes on each leaf, a short line for each of the following features: simple or compound, shape, edge, vein pattern, texture

2 Leaves vary in thickness. Some leaves are very thick and some are almost transparent. Collect ten different leaves and hold each one up to the light. Look at the vein patterns. Spread them out on a board and leave them for a while. Which ones wither quickly? Which ones stay looking quite fresh?

8 THE WORLD OF INSECTS

Insects are an important and large part of the animal world around us. There are over a million species of insects. They are found in every part of the world, though there are very few that live in seas or rivers. Some insects, like the cockroach, were first seen around a million years ago.

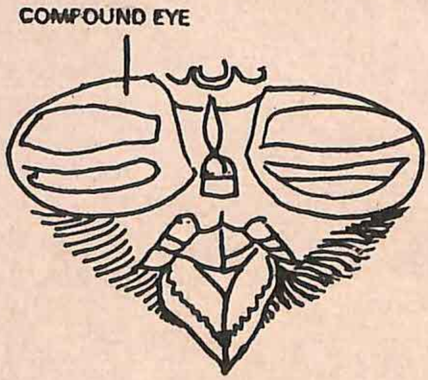
Insects are a very important feature of the world around us. They are the prey of many other animals and provide food for them. Many insects help nature get rid of dead animals by eating them. We will learn later how insects like the butterfly help plants to make fruits and seeds so that new plants can be grown from them.

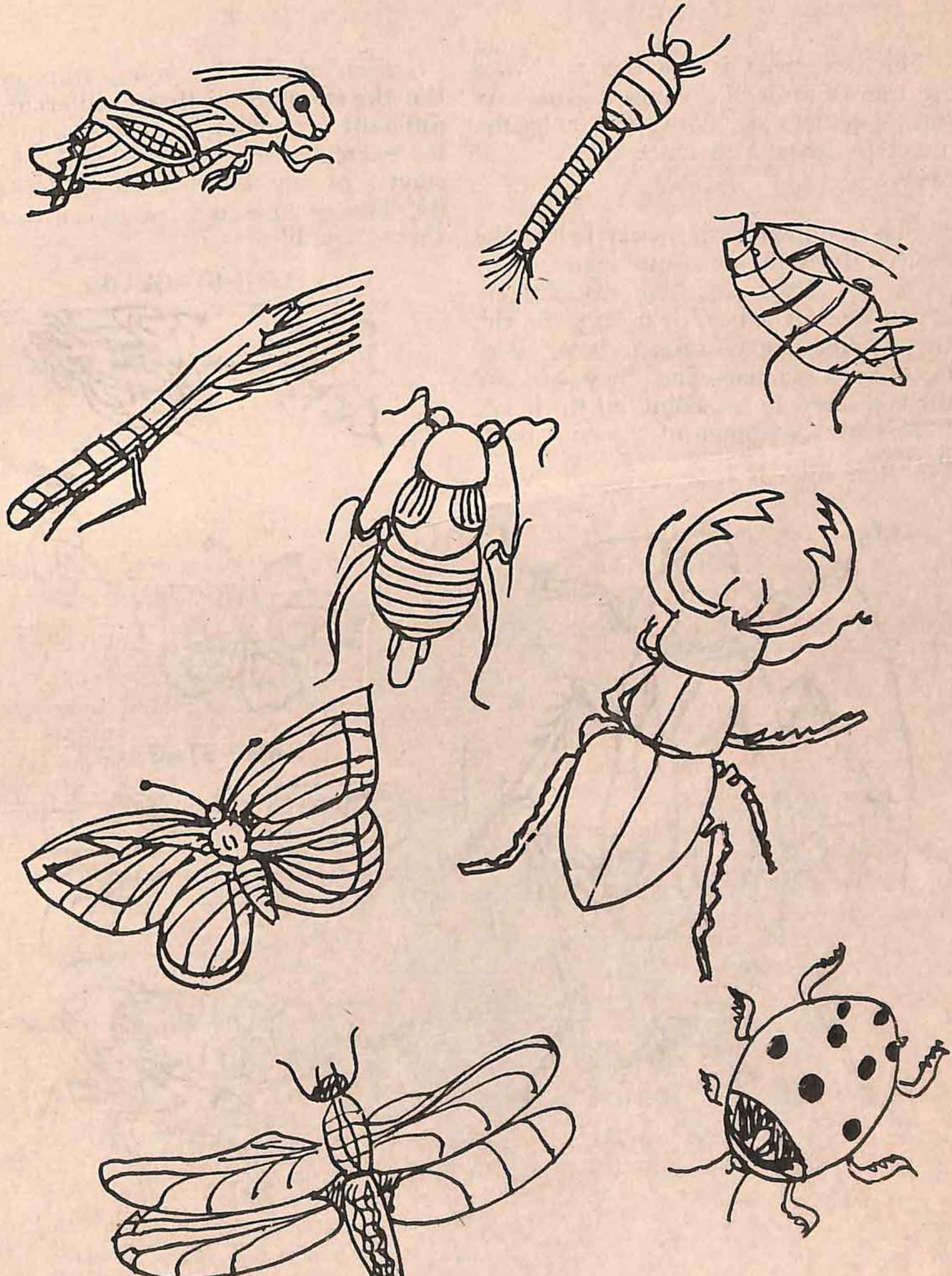
Insects play an important part in our lives. Some have been destructive and have made men think of ways and means of keeping them away. Many insects carry disease-carrying germs. There are just as many insects that help man. Among the most important of these are insects who help plant-growth by enriching the soil.

Insects have features which make them quite clearly different from birds and the larger animals. One of these features is the hard, jointed outer covering.

Another feature is the number of legs. All insects have six legs. Most insects have wings although they cannot all fly in the same way or at the same speeds.

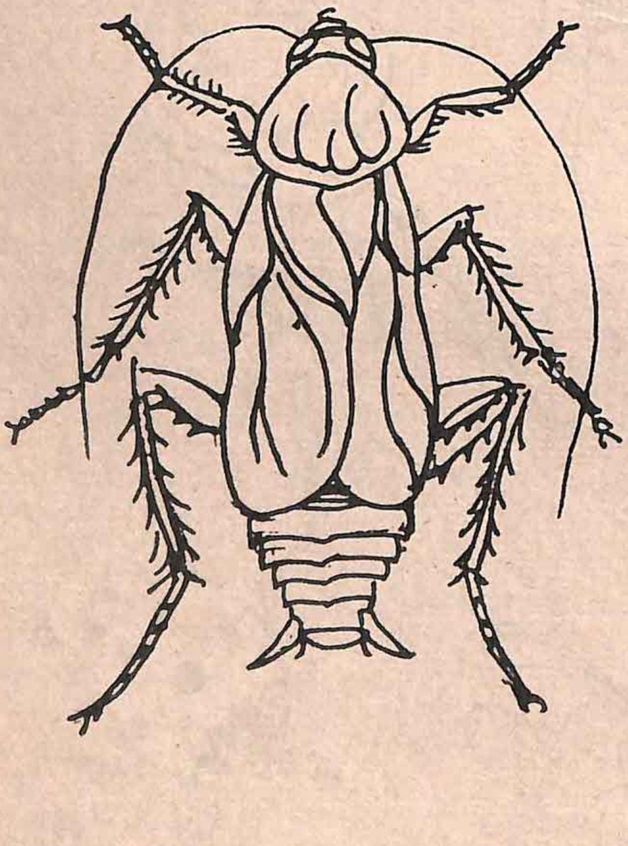
Insect bodies can be divided into three parts. The first and usually the tiniest part is the head. Cockroaches have long feelers attached to their heads to help them know what they are coming into contact with, so do butterflies. Almost all insects have prominent eyes in their heads. These eyes are called compound eyes because each eye is really a group of hundreds of tiny eyes.





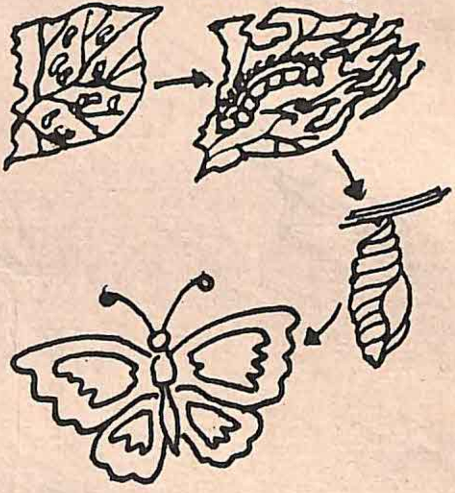
The next part is the thorax. From the thorax grow the wings and the six legs. The legs are long and help the insect to cover a distance quickly and easily.

The abdomen is the part below the thorax. It is divided into segments or parts. You can see these distinctively if you look at a bee, or a large beetle. Insects like the cockroach have holes in their abdomens and they breathe through these holes. Point out the head, thorax and abdomen of the cockroach here:

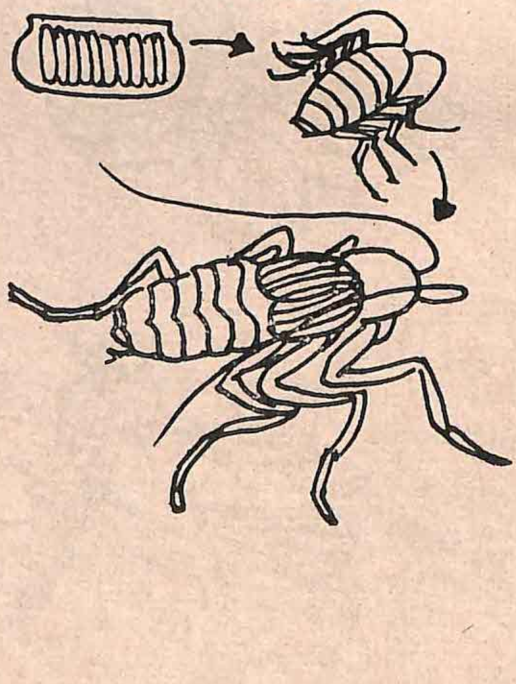


Insects hatch their young from eggs. But the stages of birth are different for different groups of insects. A butterfly for example, is an insect with a four-stage life—egg, larva, pupa and butterfly. The cockroach is an insect with a three-stage life.

FOUR-STAGE LIFE



THREE-STAGE LIFE



1 What are insects? Name ten insects you see around you.

2 Make a list of features insects have in common.

3 How are insects useful to nature?

4 What part do insects play in our world and in our lives?

5 Describe the parts of an insect's body.

1 Observe and draw 5 insects in your books. Here are some you may see easily or find in books:

beetle, fly, ladybird, ant, butterfly.

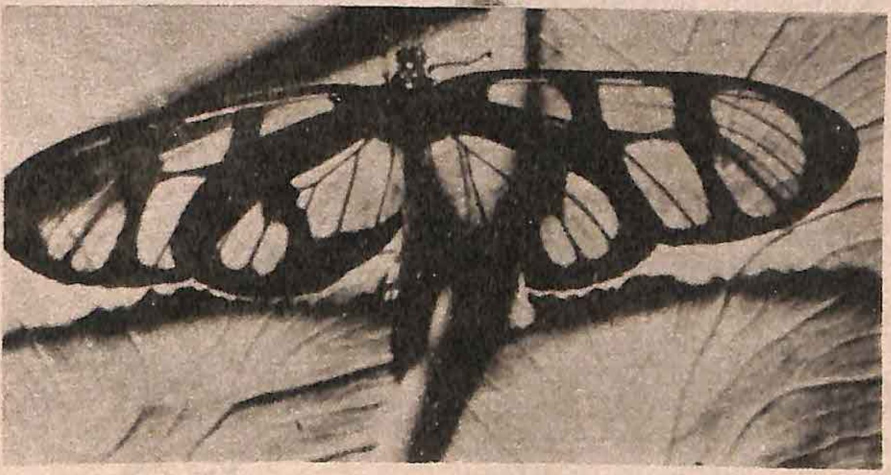
Label the parts with your teacher's help.

2 Make a list of ten insects that are around you. For each insect write a note on its colour, whether it has wings, where it is found, and what it eats.

THE STORY OF A BUTTERFLY

The world is full of so many insects that it is impossible to count them. When we say 'insect' we usually think of something small, and indeed almost all insects are small.

Insects have their young in many different ways. Some insects like the cockroach come out of eggs. They look exactly like the adult cockroach except that they are much smaller and they do not have wings.



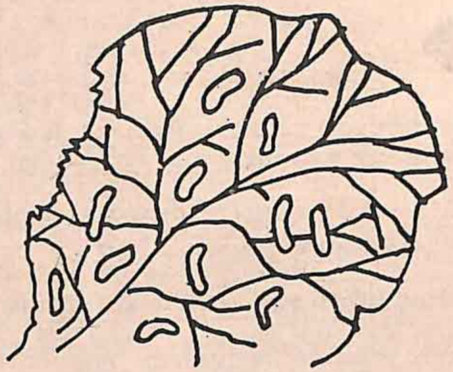
Some kinds of insects change shape as they grow. The insect we see when it is fully grown is quite different from the creature it started out as. The butterfly is one of these.

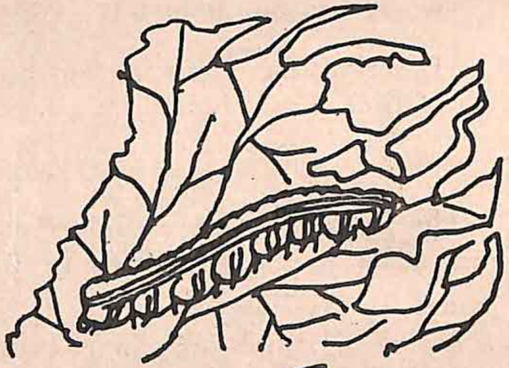
A butterfly starts as a caterpillar in an egg. The female butterfly finds a leaf to lay her eggs on, and she usually lays them on the underside of a leaf. Each egg has a larva or caterpillar inside it. The eggs hatch about a week after the butterfly has laid them.

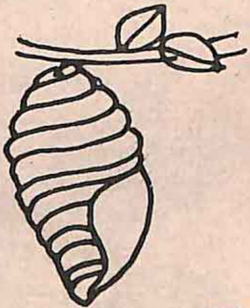
The caterpillars are small when they first come out of the eggs. But they grow and as they grow they eat everything that can be found. They eat and destroy the leaves and other leafy parts of plants. As they grow they shed their old skins and take on new ones. This happens several times until the caterpillar is fully grown. This process is called *moulting*.

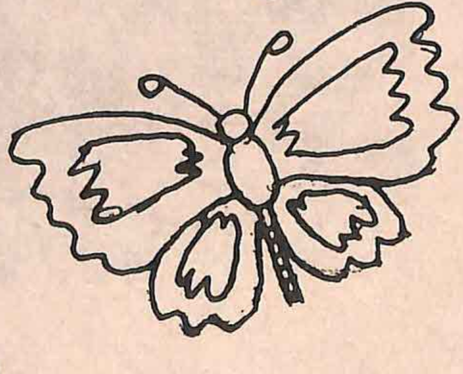
The larva or caterpillar now spins out a thread and hangs from it. It now takes on a brownish skin and spins a thick covering called a cocoon round itself. At this stage the caterpillar is called a pupa. The cocoon hangs upside down and it looks dead. Actually, a wonderful change is taking place inside the cocoon. The pupa is slowly changing and beginning to look more and more like a butterfly.

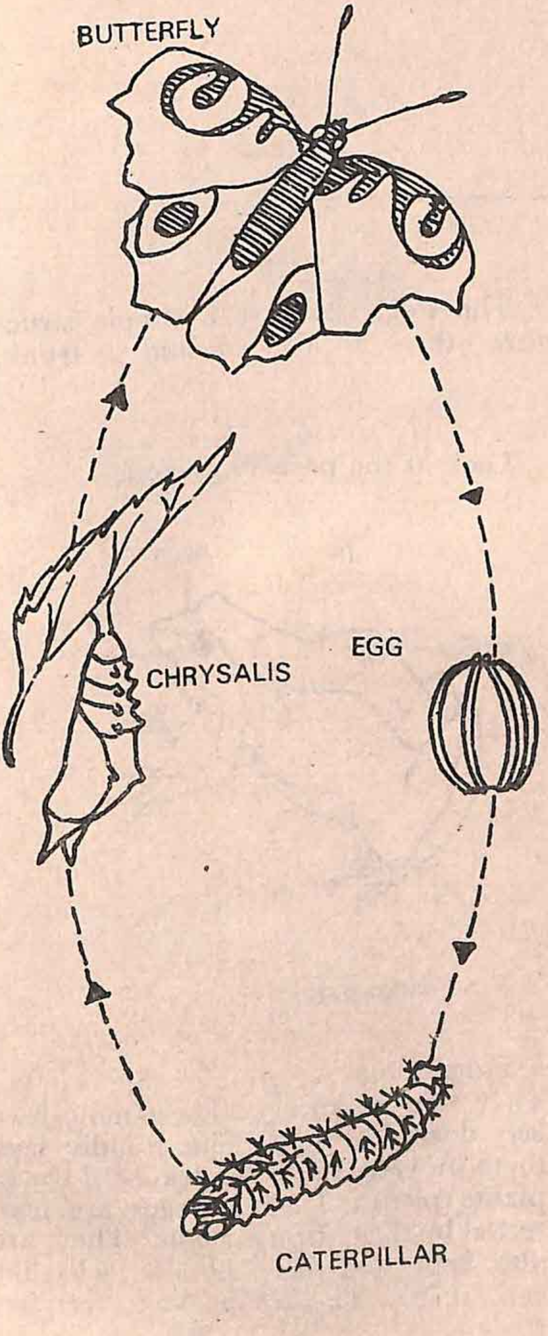
One day, when it has grown fully, the cocoon cannot hold it any longer and it opens. The butterfly comes out. Its wings are wet and sticky, but after a few minutes it spreads its wings and flies away. The silk moth undergoes the same changes. The silkworm lives on mulberry leaves.











Fill in the blanks. Then put the sentences in the order of growth of a butterfly.

1 The catterpillar now spins out a —— and hangs from it.
2 The caterpillars are hungry creatures. They eat and destroy ——— and leafy plant parts.
3 The butterfly lays her ——— on the surface of a leaf.
4 It wraps a hard outer covering called a ——— round itself.
5 At this stage it is called a pupa, and the pupa hangs ————.
6 When the ———— is fully grown it stops eating.
7 When the ———— is fully grown it comes out of the ———— and flies away.

1 You can arrange to watch all the stages in the birth of a butterfly.

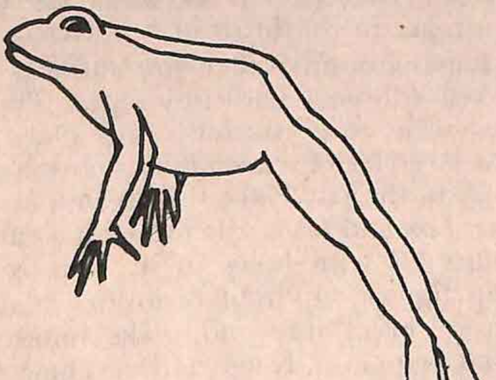
Look around under the surfaces of leaves till you find tiny eggs. Pluck away the twig carefully and place it in a large jar of water. Place more leafy twigs in the jar. Place the jar in a large glass box and cover the top with a cardboard lid with holes in it. This is to help the air to circulate inside. Watch closely every day and make notes on what happens. Keep a time chart for each stage. Make a note of colours, shapes. Let the butterfly fly away at the end of your observations.

10 AMPHIBIANS—THE FROGS

Amphibians are animals that can live both on land and in water. Their bodies are made in such a way that they can survive equally well in both places. Usually, though, they live in one or the other.

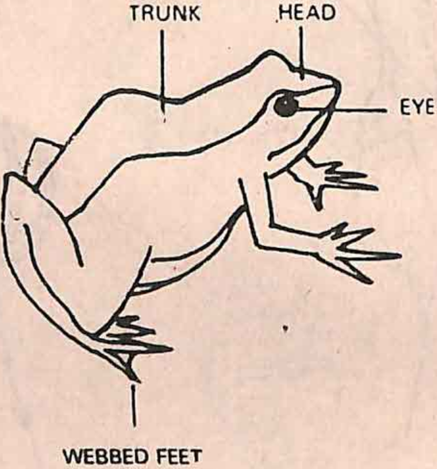
Living in water is difficult and water animals have special features that help them keep afloat or swim. Most amphibians have webbed feet. Their bodies, when swimming and leaping, look longer. They are slimy to help them move easily.

A frog is an amphibian. The family of frogs is very large, and they vary greatly in size and colour. They have long hind legs to enable them to leap and swim easily.

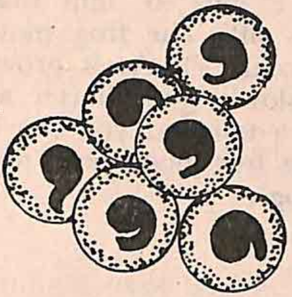


The frog's body is a simple structure—there is a head and a trunk.

Look at the parts of a frog:



Frogs have a strange life-history. They start as an egg. The female frog lays dozens of eggs. She usually lays them in water or on the leaves of water plants (picture 1). These eggs are protected by their strong shells. They are also kept together by a jelly-like substance. The male frog fertilises these eggs.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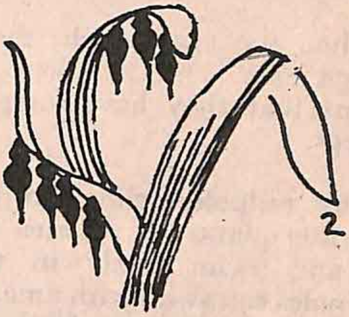
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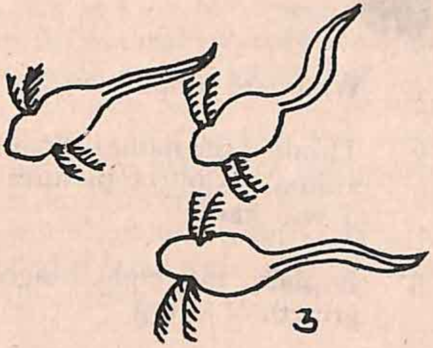
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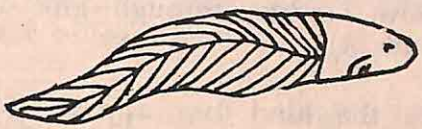
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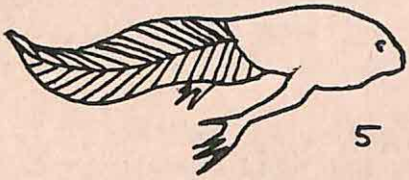
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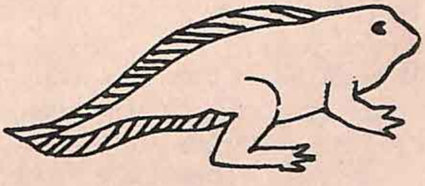
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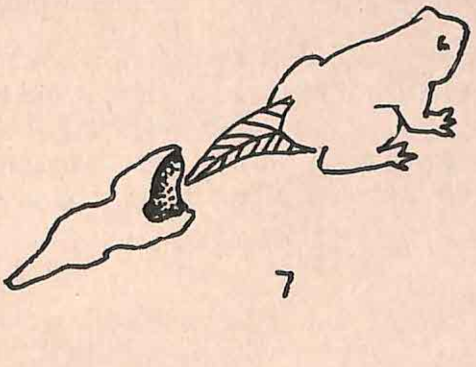
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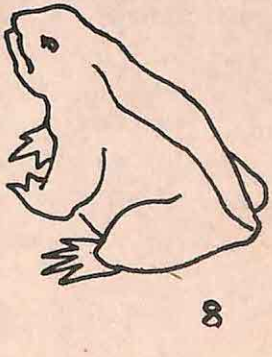

8

When the eggs hatch, the tadpoles wriggle out (1). They look like frogs except that they have long tails and no legs.

The tadpoles cling to the leaves of water-plants (2). Later they drop off and swim freely in the tanks. Tadpoles can swim with amazing speed. They breathe through feather-like flaps called gills (3).

As they grow they develop mouths. They now breathe through gills in their head (4).

Slowly the hind legs appear (5), followed by the front legs (6). The tadpole begins to look more and more like a frog. Now that the frog is growing, its outer skin stretches tightly over it. Finally, it gets so tight that it tears and falls off. The frog moves out of its old coat (7). As it grows further, its tail slowly gets shorter and finally there is a tail that you can hardly see (8). The frog now looks just like the older frogs.

1 What are amphibians?

2 Think of the names of 5 amphibian animals. Collect pictures of them if you can.

3 Explain the eight stages in the growth of a frog.

11 ANIMAL AND PLANT DEFENCES

Every animal lives in the world of *other* animals, environments and people. Animals live and act by *instinct*, a word we use for the natural ways of behaviour special to each species of animal. All animals have an instinct to protect themselves and their young ones from harm. They have to defend themselves against it and survive in a world of danger, and animal enemies. Nature has provided animals with some defences. Let us look at some of them.

One of the commonest defences is the sting. Bees and scorpions sting in defence. Scorpions leave a poisonous sting behind on the surface of what they bite. The man or animal bitten is paralysed with the painful poison.

Teeth are another important protection. Some animals like the dog and the jackal have sharp teeth They 'bare' them warningly in case of any approaching danger.

Many animals we know have horns, and horns are another means of defence. The buffalo, the bullocks, the deer, the rhinoceros have horns. In a situation of danger they fling their heads down and charge at the enemy to butt it with their sharp horns.

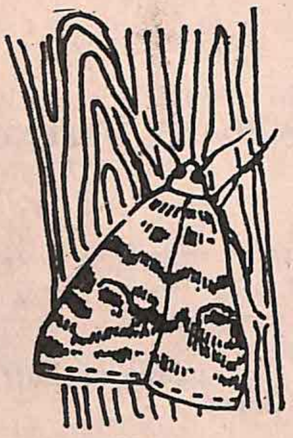
Cats and bears have sharp claws. In birds these thick, strong, sharp claws are called talons.

Have you come across insects that look like their surroundings? The stick insect looks so much like a stick in colour and shape that you can easily mistake it for a stick! The leaf-insect fools its enemies into thinking it is a leaf.

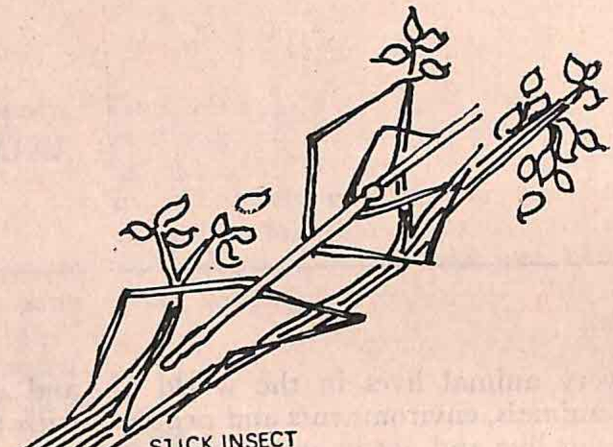
On the picture on page 102 you can also see how the moth looks like wood and it is difficult to tell the moth from the wood.

Shells are another important protection. Animals like the turtle and the snail have thick shells. They go into their shells when any danger threatens.

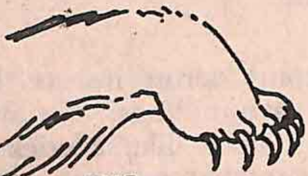
Have you seen a rabbit or a deer run? Nature has provided them with light bones and strong muscles which enable them to run away swiftly in case of danger.



MOTH
(CAMOUFLAGE)

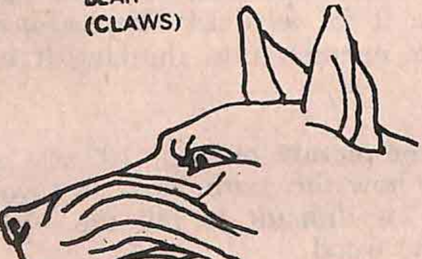


STICK INSECT
(CAMOUFLAGE)

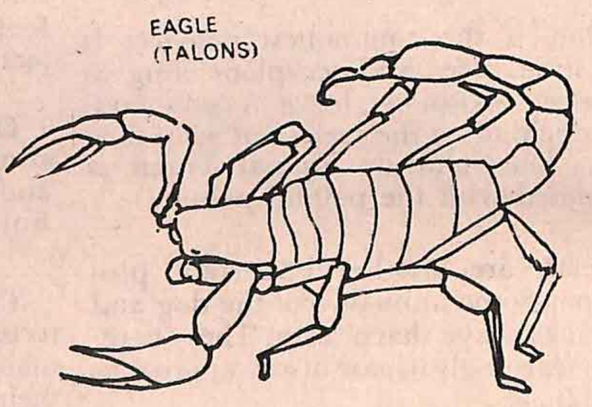


BEAR
(CLAWS)

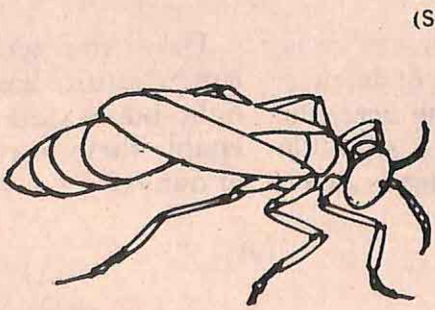
EAGLE
(TALONS)



JACKAL
(TEETH)

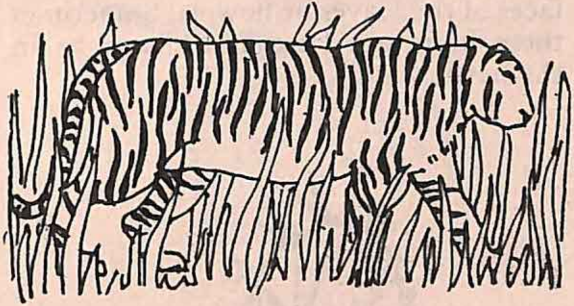


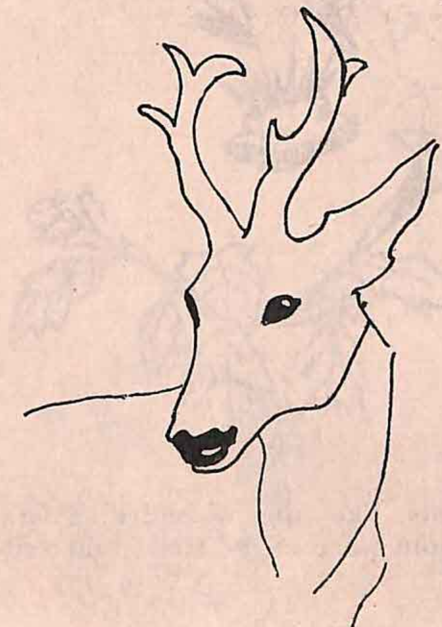
SCORPION
(STING)



WASP
(STING)

Here are some pictures of other defences. Can you say what they are?





1 What are the various kinds of defences that animals have?

2 Can you think of any defences other than those mentioned in this chapter?

3 Which of these are defences and which are not?

a porcupine's quills

a camel's hump

a fish's gills

an elephant's tusks

a wasp's sting

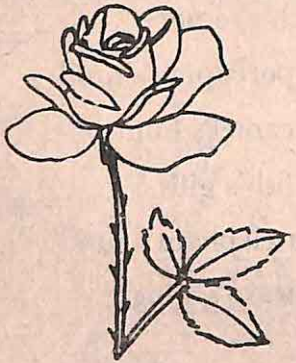
1 Find out about other unusual animal defences. How are they used?

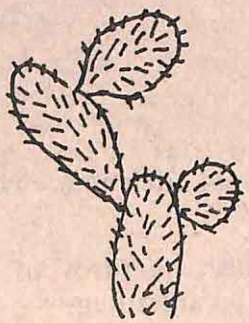
2 Collect pictures of animals that use a camouflage to protect themselves.

PLANT DEFENCES

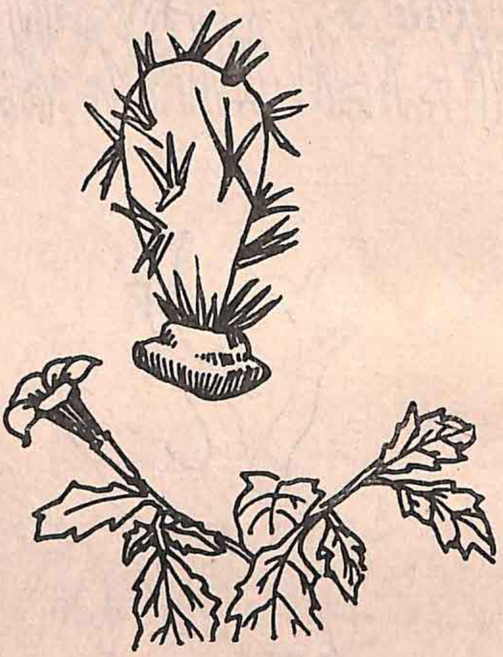
Like animals, some plants also have to protect themselves from harm.

One of the commonest plant defences is thorns. The rose and the bougainvillea have sharp thorns. Can you think of any other plants that make use of thorns?





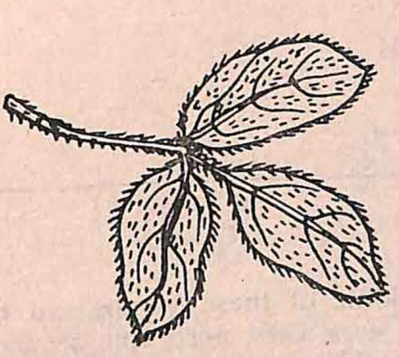
Some plants have hairs on the surfaces of the leaves or flowers. Sometimes these hairs are long and sharp, as in the nettle.

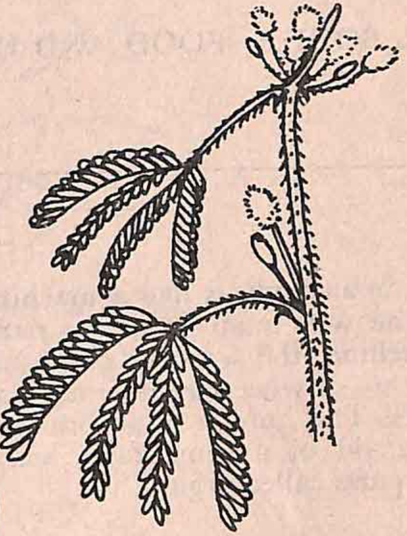


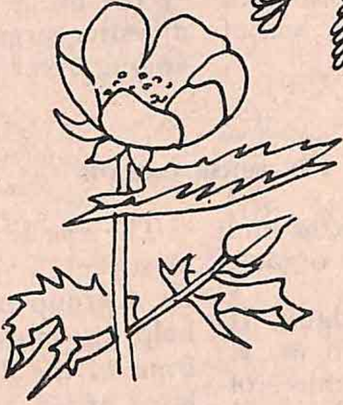
Plants like the oleander have a poisonous juice in the stalks and veins.

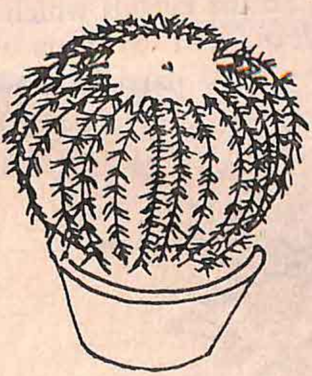
1 What are some of the common plant defences?

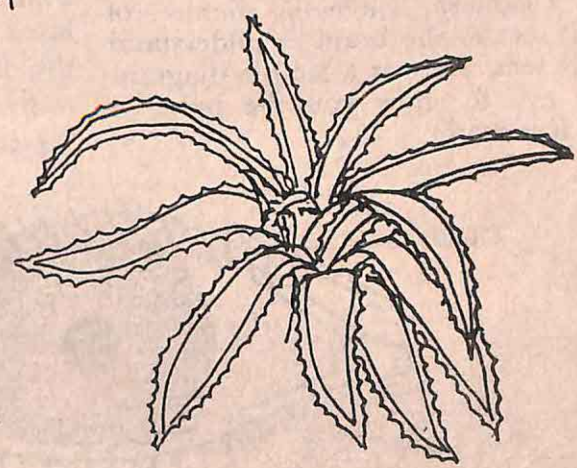
2 Can you think of any other defences? Describe them and say how they are used. (See page 105.)











12 OUR BODIES, FOOD AND HEALTH

The human body is like a machine, a machine with many working parts. In a machine, the working parts may be made up of wheels, gears, rods, bars and belts. The human body functions with the aid of a remarkable set of working parts called organs.

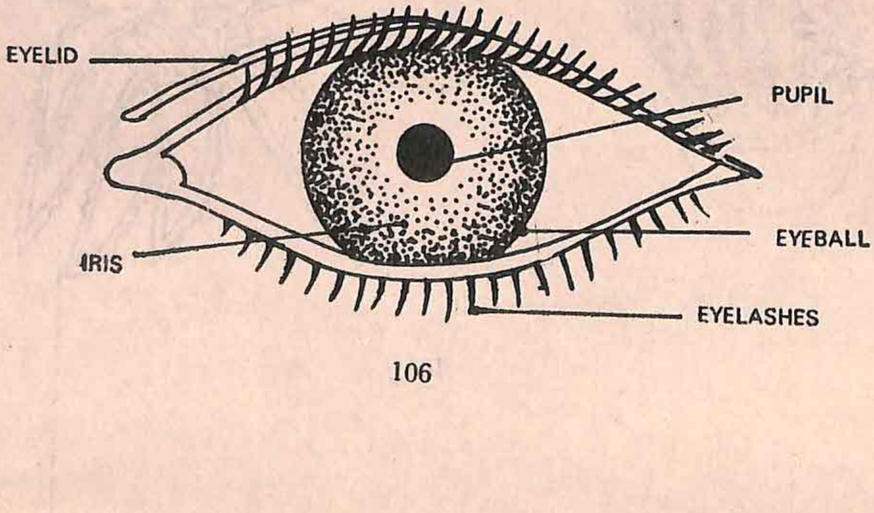
Some of these organs can be seen: the eyes, ears, nose, tongue, hands and feet. There are other important organs in the body which we cannot see, such as the brain, the lungs, the heart, the digestive organs and the blood vessels among other things.

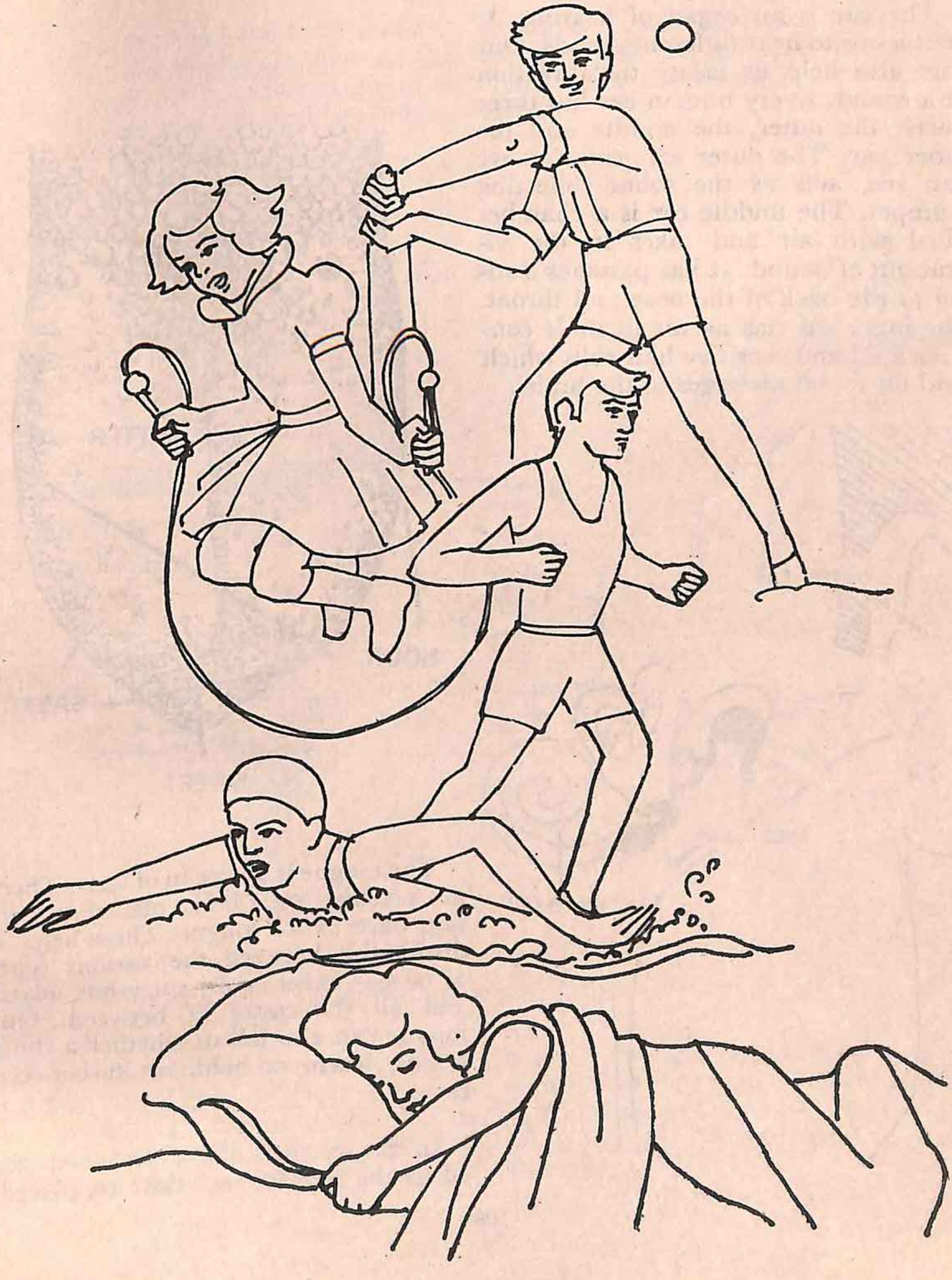
THE SENSE ORGANS

You can see, hear, smell, taste and feel with the help of your sense organs.

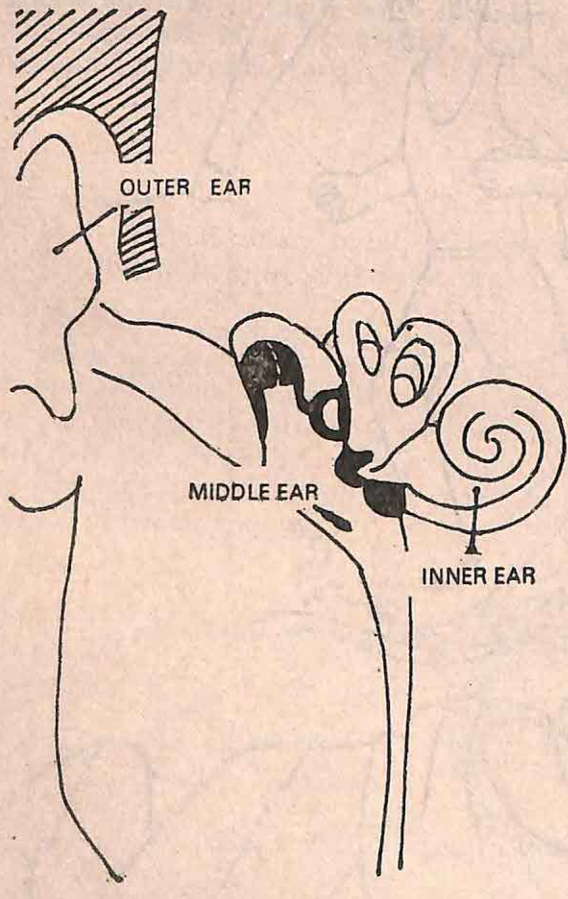
The eye is an organ of sight. It enables us to see things around us. It is like a camera, conveying pictures of what it sees to the brain to understand what it sees. Here is a simple diagram of the eye to show you the parts of which it is made.

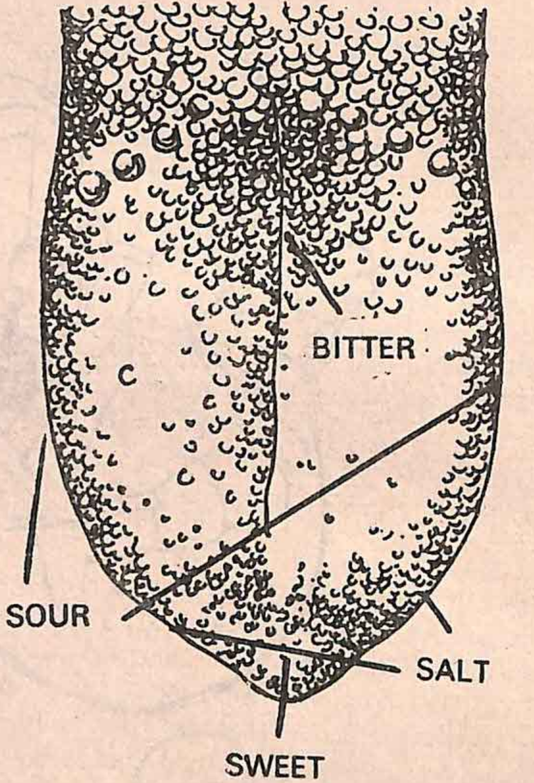
The eye is protected by a bony nest or socket. It is attached to this socket by a group of delicate muscles which help us move the eye around. The front of the eye is also protected by a layer of fat, by the eyelids which wipe the front clean, and by tears which wash out the dust particles and kill bacteria.





The ear is an organ of hearing. It enables us to hear different sounds. Our ears also help us locate the direction of a sound. Every human ear has three parts: the outer, the middle and the inner ear. The outer ear, the flap we can see, acts as the sound-collecting trumpet. The middle ear is a chamber filled with air and takes in the vibrations of sound. It has passages leading to the back of the nose and throat. The inner ear has no air in it. It contains fluid and sensitive hair cells which send on sound messages to the brain.



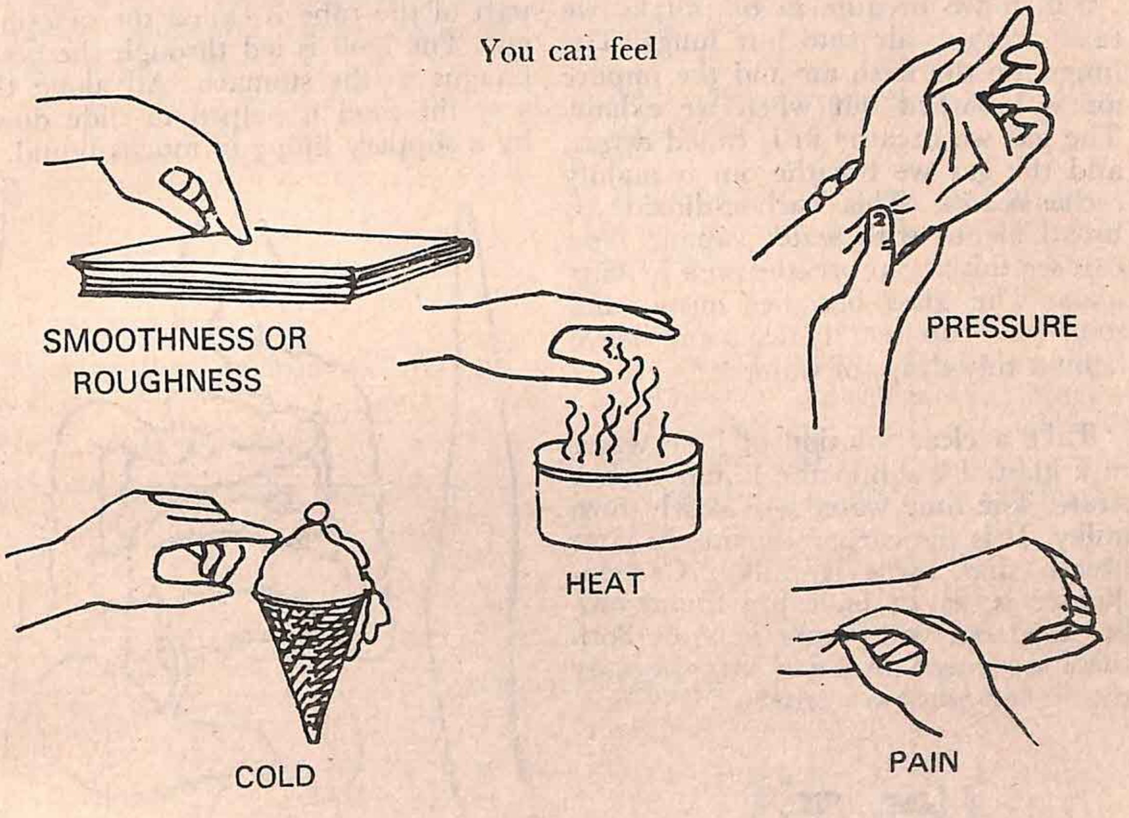


The tongue is an organ of taste. There are sensitive taste buds placed on certain parts of the tongue. These help us distinguish between the various types of tastes—sweet, sour, spicy-hot, bland and all the tastes in between. Our tongue can also tell us whether a thing is hot, warm or cold, or in between these.

In the picture above you can see where the buds for each taste are placed.

The skin is one of the most remarkable of all our organs. It gives us the sense of touch. It is, in fact, a group of five different ways of feeling: touch, pressure, heat, cold and pain. We are also able to tell the texture of things with the sensitive parts of our skin.

You can feel



OUR ORGANS WORK TOGETHER

Our organs, as we know, have different functions. They perform functions like breathing, digesting, circulating blood to all parts of our bodies and removing waste materials from our bodies. The different organs work together, and they help the body-machine to function smoothly. They also help when danger of any kind threatens the body.

Breathing

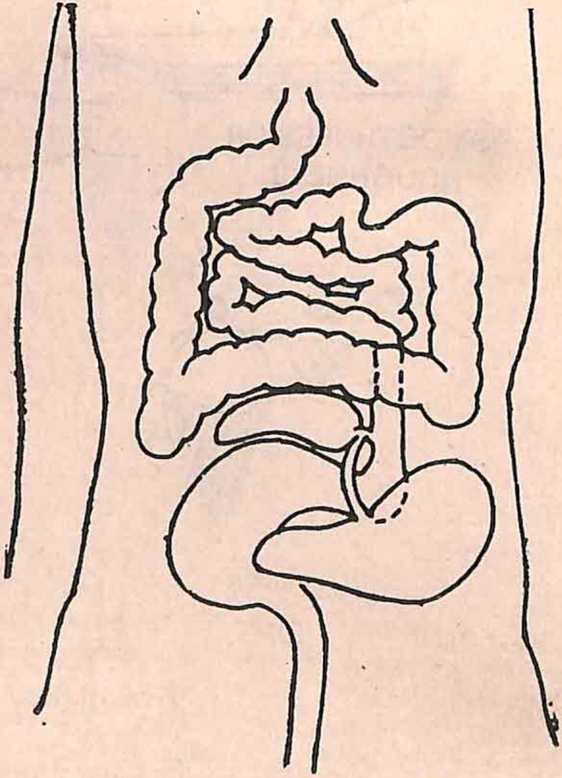
When you take a deep breath, you can feel your chest expand. Your lungs fill with air and cause the chest to expand. As you breathe out your chest contracts.

When we breathe in or inhale, we take fresh air into our lungs. The lungs use the fresh air and the impure air is breathed out when we exhale. The gas we breathe in is called *oxygen,* and the gas we breathe out is mainly *carbon-dioxide*. This carbon-dioxide is breathed out with water vapour. You can see this if you breathe on a looking glass. The glass becomes misty, and soon you can see it clear and leave behind tiny drops of water.

Take a clear solution of lime water in a glass. Blow into the liquid with a straw. The lime water will slowly turn milky. It is the carbon-dioxide in your breath that turns it milky. Carbon-dioxide is, as we have just found out, breathed out with water vapour. Both these are 'waste products' that the body throws out when we exhale.

Digestion

When we chew food and swallow it, the process of digesting it has begun. If you look at the picture you can see that a canal starts from the swallowing end of the mouth. The chewed food is led through a narrow tube. The lower part of the tube is called the oesophagus. The food is led through the oesophagus to the stomach. All along the way the food is helped to slide down by a slippery lining of mucus liquid.



In the stomach, the food is crushed further. The juices of the stomach (called enzymes) act on the food and break it up into simple substances. They are made into a solution and the food now passes into the intestines. Here it undergoes more chemical changes, and organs such as the liver help to separate what the body needs and can use, from waste matter. The dissolved food is then absorbed into the blood, while the waste matter is sent out of the body.

1 Name the sense organs. Describe the work of each.
2 Describe the structure of the ear and eye.
3 How is food digested?
4 What happens when you breathe?

Find out why

1 you breathe faster when you run.

2 you are able to swallow your food easily.

3 your chest expands when you breathe in.

4 why you can breathe in and out through your mouth as well as your nose.

5 how much of your classroom you can see if you look straight ahead; if someone comes near you from the back, and you are looking ahead, at what point do your eyes tell you that the person is coming?

FOOD, EXERCISE AND HEALTH

Our bodies are remarkable machines. They are built up from millions of tiny cells. These cells in turn form groups to make up tissues and organs, some of which we have just read about.

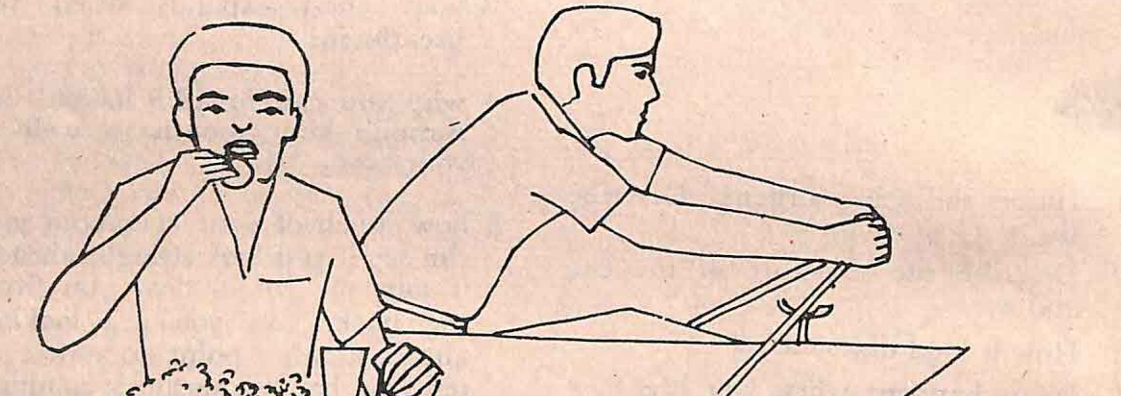
In many ways, your body looks after itself. Your skin is made in such a way that it keeps the body cool when it is hot. When it is cold your skin makes sure that not too much body heat is lost.

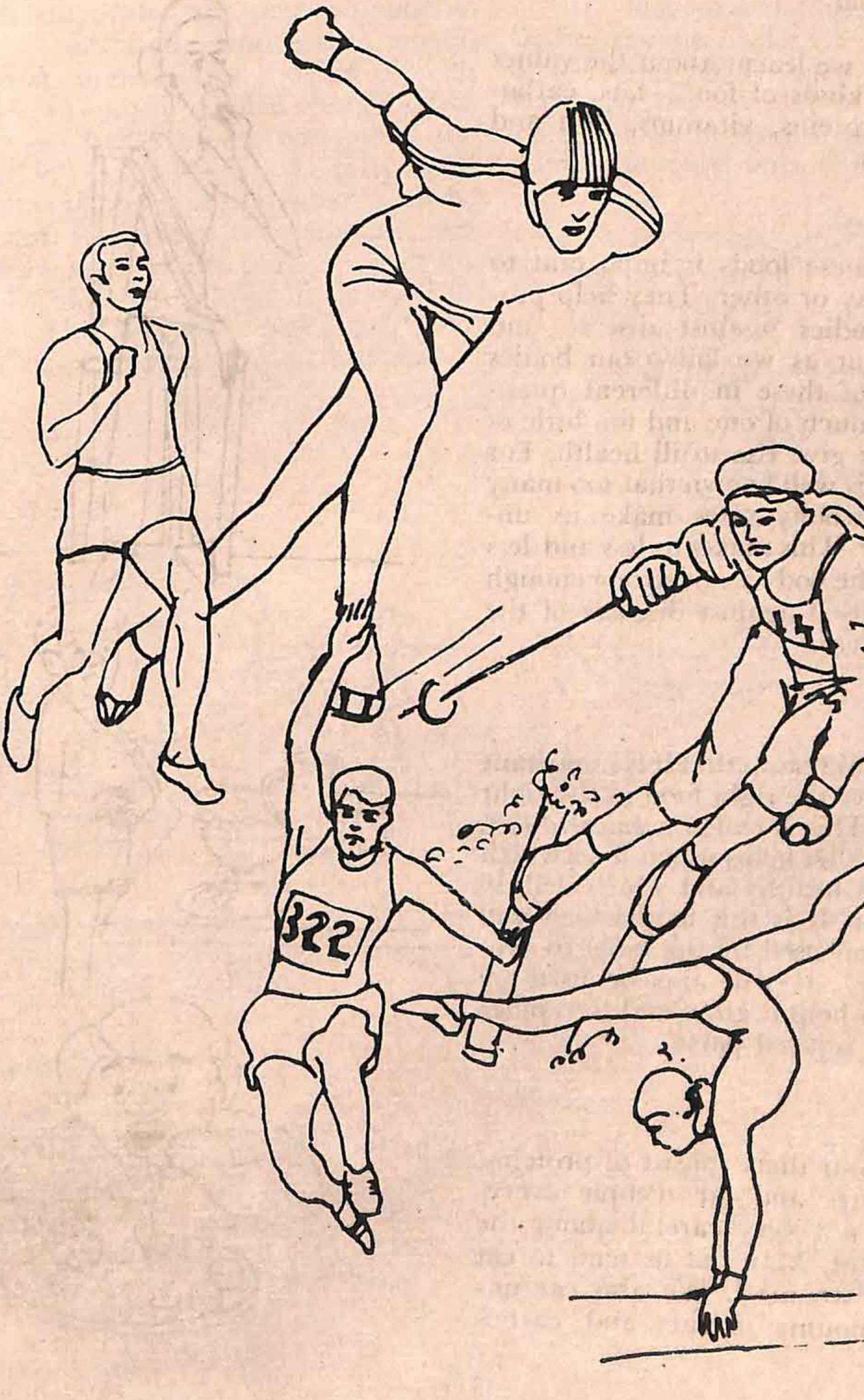
Our muscles work along with the bony structure of our skeleton and they help the body move. They also help it to obey the brain. The other organs inside our bodies help us use the food we eat and the air we breathe so that we stay alive. The blood system spread throughout our bodies carries the fuel-power from food to the organs of the body.

Our organs work in such a way that waste matter is thrown out of our bodies. Impure matter from the blood is also taken out.

Your body thus looks after itself. But it would not be able to do so for long without your help. This is why it is necessary for us to look after our bodies and see that they are kept healthy.

Two important ways of making sure of this are proper food and proper exercise and rest.

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15

The food we eat

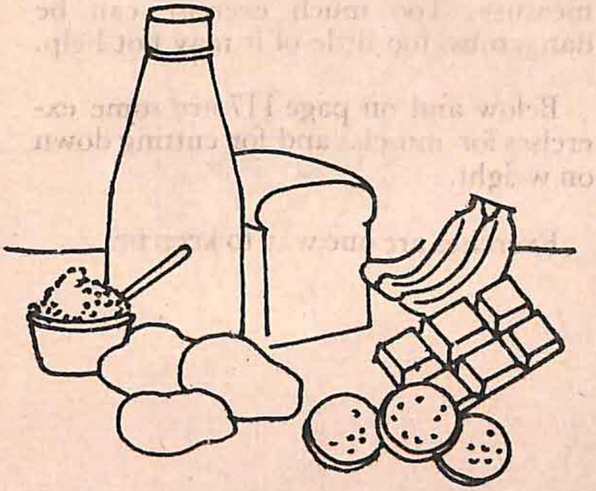
In Book 3 we learnt about the values of different kinds of food—fats, carbohydrates, proteins, vitamins, iron and mineral salts.

Each of these foods is important to us in one way or other. They help protect our bodies against disease and weakness. But as we know our bodies need each of these in different quantities. Too much of one and too little of another can give rise to ill health. For example, it is well known that too many fats and carbohydrates make us unhealthily fat. This makes us less and less active and the body is not strong enough to protect itself against diseases of the heart and liver.

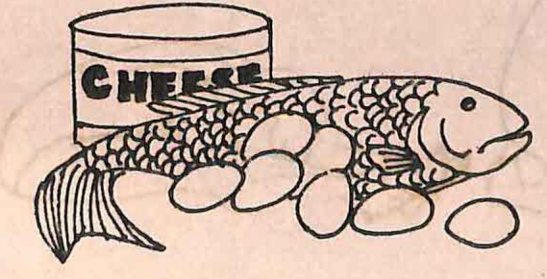
It is for this reason that it is important for us to have the right food in the right quantities. This is called a *balanced diet*. A balanced diet helps us eat food which will keep us healthy and which will do us no harm. It is this food which will be burnt and used by the body to produce energy. It will also be used by the body to help it grow and to replace the cells in injured parts.

Most of our diets consist of proteins, carbohydrates and fat. People everywhere are not very careful about the food they eat. Many of us tend to eat more than we need. We also eat unhealthy amounts of fats and carbohydrates.

Carbohydrates are very common in most of our main foods—rice, bread, potatoes, sugar. They provide us with energy, so they are called energy foods. But carbohydrates do not build the tissues in our bodies. In the fatty foods we eat, the body uses up what it needs. The rest, which is a large amount, gets stored as fat in various parts of our body. It is for this reason that if we want to lose weight, the most important thing is to cut out carbohydrates and fat.

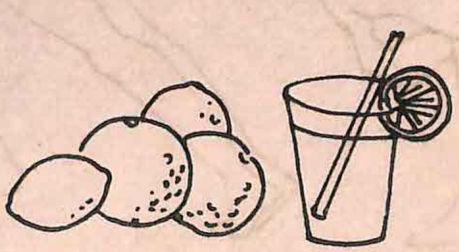


Proteins are a very necessary part of our food. They build the tissues and growing children need this.



Fat, like carbohydrates, gives our bodies energy. A lot of the fat we eat comes from meat and the animal and vegetable oils we use in our cooking. People suffering from heart diseases are advised to avoid animal fats.

Vitamins are another necessary part of food. The body cannot make them on its own, so we must eat foods that contain them. Lack (this is called a *deficiency*) of a particular vitamin may have an effect on the body. A deficiency of vitamin A can make our eyesight poor. Vitamin C, found in many fruits like oranges and lemons, helps us protect ourselves from colds.

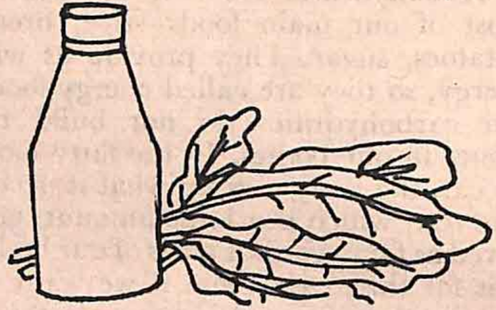


There are about twelve minerals which are important in our daily diet. Many of these are found in water. Calcium and iron are minerals and they are found in milk.

A balanced diet need not be an expensive one. Some of the cheapest foods are rich in the things we need.

Exercise

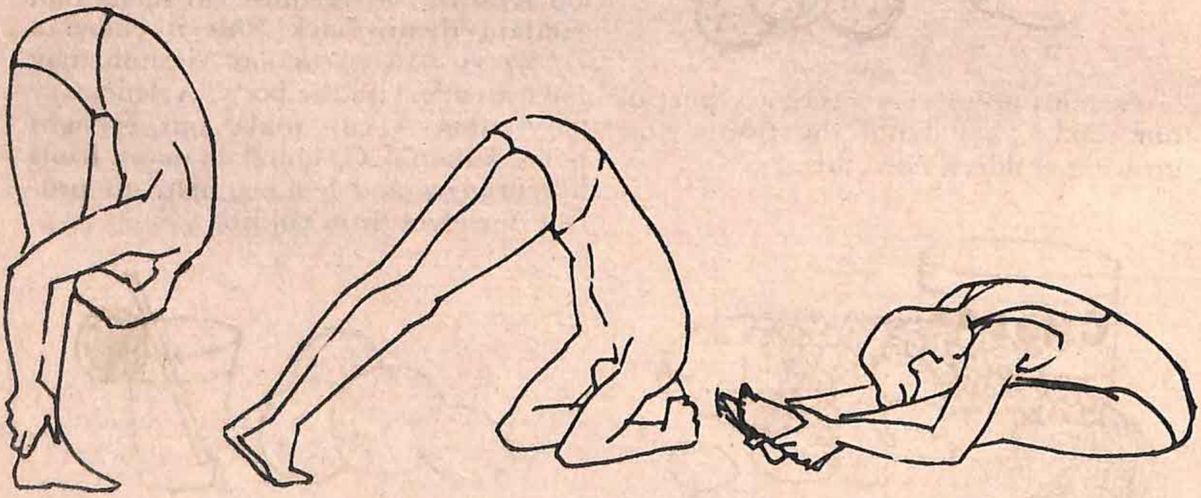
Exercise keeps our bodies fit It helps to keep it in a good working condition. Exercise can also be a way of *mending* things which might have gone wrong with our body. Muscle exercises tone up our muscles. Breathing exercises help us improve our lungs.

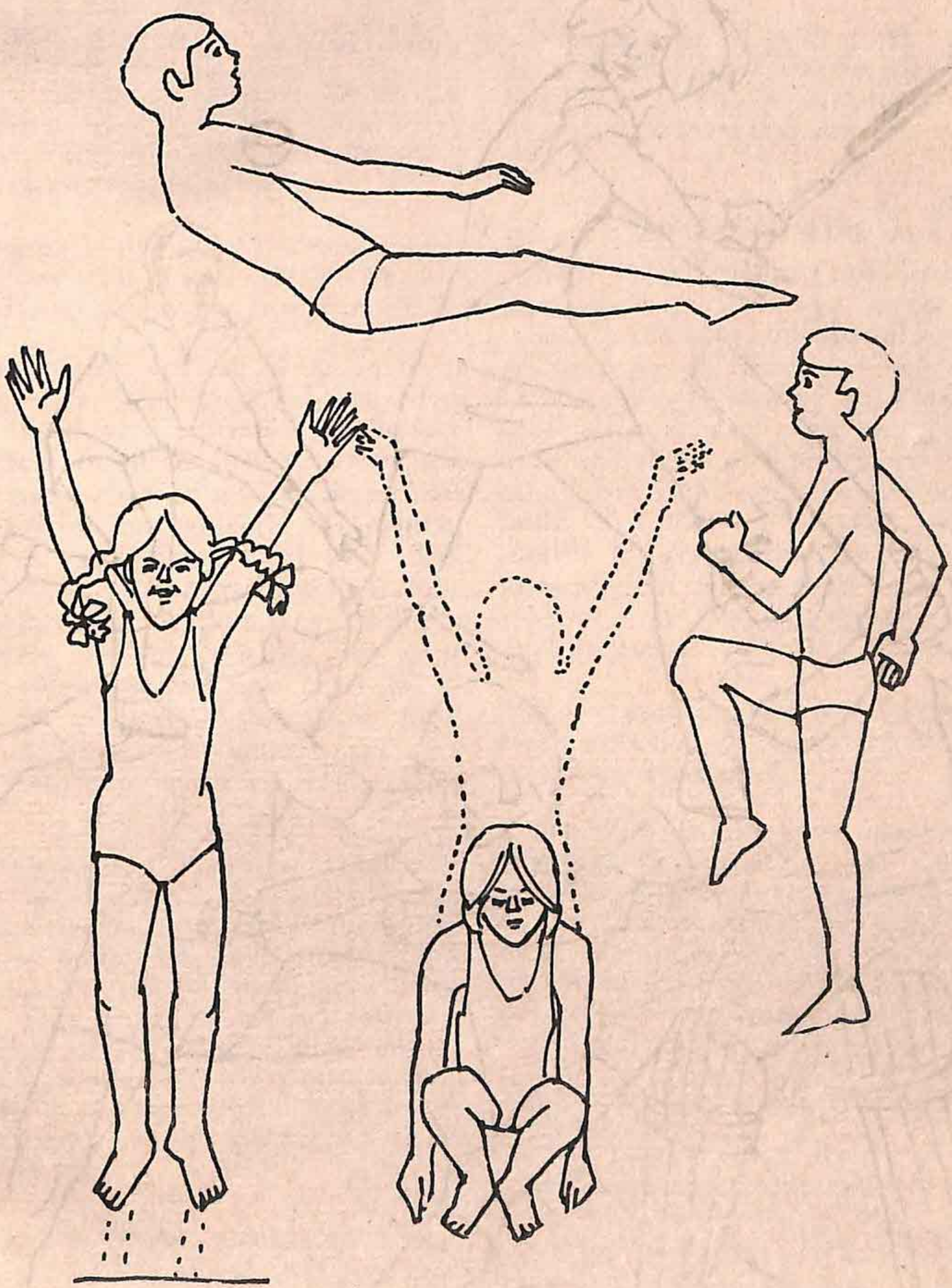


Like all things, exercise must be done in the right way and in the right measure. Too much exercise can be dangerous, too little of it may not help.

Below and on page 117 are some exercises for muscles and for cutting down on weight.

Exercises are one way to keep fit.





CARE OF SKIN AND TEETH

The skin needs care. It is open to the effects of sunburn or cracking in severe cold. We must see that it is kept clean, moist and oily.

A grown up person should have thirty-two teeth in all—sixteen in each jaw. Do you have thirty-two teeth?

Good teeth are useful to man in many ways. With teeth we can chew food. Teeth give expression to the face and help us speak clearly. There are three basic kinds of teeth. The incisors are used for cutting food. The canines are used for tearing hard food. The molars are used for grinding food. The premolars are also molars. Children lose some of their teeth but they grow again. New molars grow later on to make up a total of thirty-two. How many teeth have you lost up to now? How many new ones have come in their place?

Our teeth need a great deal of care. When we eat food, the particles get lodged between the spaces in the teeth. The food matter begins to decay. Small germs or bacteria begin to attack our teeth. This leads to tooth decay and a rotting of the tooth called caries. Caries is a kind of brown matter that collects on the biting surfaces of teeth. If the caries is very deep, the tooth may fall off.

Tartar is another problem. This comes from the saliva and removes the outer polish or enamel of the teeth.

Most problems with teeth can be avoided by careful and regular brushing. It is most important to brush your teeth before you sleep.

COOKING FOOD

Some foods are eaten raw. Fruits are generally eaten raw and so are some vegetables. These foods should be washed properly in clean and safe water before eating. Chewing hard helps to keep our gums and teeth healthy. Vitamins and minerals found in raw vegetables and fruits are necessary for our body. Cut fruits, if exposed, become spoiled by germs, dust and flies. We generally eat cooked food. One has to remember the following tips for cooking healthy food.

1. Overcooking destroys vitamins the body needs. Care should be taken to avoid overcooking.

2. While cooking, we should make sure that the water used for boiling is not thrown away or wasted. Since most of the vitamins and minerals are found in it, the water should be allowed to remain in the food that is prepared. It is a great loss to throw away the water that is cooked with rice.

3. Cooked food is soft. It is, therefore, easily digested.

4. Cooked food tastes better if we do not add too much water. We find, for example, that soup containing less water tastes better than the one with more water.

5. Cooking makes food safer to eat. Heat destroys harmful germs.

DIFFERENT WAYS OF COOKING FOOD

Boiling is a common method of cooking. Rice is boiled. Most other food-stuffs are prepared by boiling.

Food can be prepared by steaming. Steamed food is soft and easily digestable. Pressure cookers are used for steaming vegetables, meat and so on. Because of the high pressure in the cooker, the food is cooked in a short while.

Potato chips are fried in oil. This kind of frying is called deep frying. Fish, papads, bajji etc are deep fried.

Roasting is yet another method of preparing food. Meat is roasted to produce a special taste. Nuts are also roasted, and most people like roasted groundnuts.

PRESERVING FOOD

Certain food-stuffs are salted and dried to be used when desired. Dry fish is used in places where fresh ones are not available. Vegetables and meat are also dried and used. Even fruits are dried for use at a later date.

Pickling is another method of preserving food. Salt and vinegar are used for preserving food for a long time.

Meat is smoked and preserved in some places. Sugar syrup or honey is a good preservative. Fruits are often preserved in sugar syrup or honey. Jams and fruit juices are good examples of preservation with sugar.

Most fresh food, either raw or cooked, can be kept for several days in refrigerators. Food keeps longer in lower temperatures.

Dry foods like rice and pulses are preserved by storing them in proper containers.

WRITE

1. Mark the three basic kinds of teeth in the diagram and label them.
2. In what way is cooking food healthy? Why is overcooking bad?
3. Describe three ways of cooking.
4. Name three ways of preserving food.
5. Why do people keep eggs, meat and vegetables in refrigerators?

1 Why is it important for us to eat the right kind of food?

2 What is a balanced diet?

3 Which common foods contain

a) carbohydrates

b) fats

c) proteins

d) mineral iron

e) vitamin C.

4 What effect do carbohydrates have on our health?

5 Why do our bodies need exercise? Why is too much exercise bad?

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